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D. W. MAY, Special Agent in Charge.

Mayaguez, February, 1906.

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Bulletin No. 7.

VEGETABLE GROWING

IN

PORTO RICO.

BY

H. C. HENRICKSEN,

Horticulturist, Porto Rico Agricultural Experiment Station.

UNDER THE SUPERVISION OF

OFFICE OF EXPERIMENT STATIONS,

U. S. DEPARTMENT OF AGRICULTURE.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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PORTO RICO AGRICULTURAL EXPERIMENT STATION.

[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations, United States Department of Agriculture.]

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Withdrawn
8/12/48

LETTER OF TRANSMITTAL.

PORTO RICO AGRICULTURAL EXPERIMENT STATION,
Mayaguez, P. R., February 1, 1906.

SIR: I have the honor to transmit herewith a manuscript by H. C. Henricksen on the subject of Vegetable Growing in Porto Rico.

The idea prevails in some sections that vegetables of good quality can not be produced in Porto Rico. The results attained at the Porto Rico Experiment Station, and the experience of practical growers in different parts of the island, happily show that this is a mistake. In nearly all portions of the island the climatic conditions are very favorable, while the potentiality of Porto Rican soils has hardly been touched. Not only may the condition of the inhabitants of the island be greatly improved by growing more and better vegetables, but the exportation to the States should yield a very handsome return. The results obtained by planters in various parts of the island show that successful vegetable growing is not confined to any one section.

This bulletin has gone into the subject in detail, as it has been found that methods applicable in temperate regions require modification in the Tropics. While at first glance some of the methods may seem of minor importance, yet they represent the difference between success and failure under Porto Rican conditions.

I respectfully recommend that this manuscript be translated into Spanish and published in both English and Spanish as Bulletin No. 7 of this station.

Respectfully,

D. W. MAY,
Special Agent in Charge.

Dr. A. C. TRUE,
Director Office of Experiment Stations,
U. S. Department of Agriculture, Washington, D. C.

Publication recommended.
A. C. TRUE, *Director.*

Publication authorized.
JAMES WILSON,
Secretary of Agriculture.

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VEGETABLE GROWING IN PORTO RICO.

GENERAL CONSIDERATIONS.

Porto Rican families grow but few vegetables. The home garden is usually limited to yams, yautias, and sweet potatoes, since these vegetables are easily grown and practically free from disease. The common vegetables of temperate regions are not so easily grown, are more subject to disease, and less is known as to the proper methods of growing them. The general belief is that vegetables can not be successfully grown in Porto Rico. Results at this station and the reports of growers in many different parts of the island indicate that, by the use of good seed and proper cultural methods, nearly all the vegetables grown in temperate regions can be successfully grown here.

In the large cities of the island such vegetables as beans, carrots, chard, eggplant, endive, lettuce, okra, parsley, peppers, pumpkins, radishes, and tomatoes are quite frequently found in the markets, and sometimes beets, cabbage, cucumbers, onions, muskmelons, and turnips; but there is no continuous supply of any of these. Most of these vegetables are of inferior quality. One of the reasons for this is that they represent simply the surplus of the home gardens within a radius of several miles of each city. They are not brought in with any regularity, but simply whenever it happens to be convenient. The business of growing vegetables for either home or distant markets is practically unknown in Porto Rico, although the market price of vegetables is good. Onions sometimes sell for 8 to 10 cents and potatoes for 3 to 7 cents per pound.

One serious obstacle to gardening in Porto Rico is the difficulty of obtaining good seed. The home-grown seed is not selected with care, and imported seed rapidly deteriorates and within eight to ten months is practically worthless. Another difficulty is the heavy tropical rains that greatly injure germinating seeds and young plants. Plant diseases, due to a prolonged wet season, are also serious. Porto Rican homes are usually built on the hills and higher ground where the conditions for vegetable growing are not so favorable as in the valleys. The water supply which is nearly always necessary for successful vegetable growing is very inadequate. Wells are practically unknown. The rain-water cistern is seldom large enough for irrigation purposes and it is usually impracticable to carry water from the streams

During the past season the station has conducted very extensive experiments with vegetables to determine what kinds can be grown

successfully, what varieties are best adapted to the conditions at Mayaguez, the time of year most favorable for planting, and the enemies that attack the crops. In general the results have been very encouraging. Nearly all the vegetables commonly grown in the United States were grown more or less successfully at the station at sometime during the season. Should further experiments confirm the work of the past season there would appear to be no reason why Porto Rico should not compete successfully with Florida and Cuba in supplying the northern markets of the United States with all the staple trucking crops during winter.

It is not the purpose of this bulletin to give a detailed record of the work with vegetables at the station during the past year. It is recognized that one season's work of this kind does not form a sufficient foundation upon which to base definite conclusions or make definite recommendations. In other seasons and with other conditions the results with particular vegetables or varieties may be different. Six crops of vegetables have been grown during the past year and detailed records of the results kept. When the station has accumulated data of this kind for a number of seasons, so that the average results obtained have a definite meaning, they will be published. At the present time it has seemed desirable to present in a popular way some of the general principles of vegetable gardening which apply everywhere, together with practical suggestions regarding the growing of each of the more common kinds of vegetables, based upon the general knowledge of the subject as far as it may be applicable in Porto Rico, and upon the results secured at the station, and by practical vegetable growers in various parts of the island.

SOILS AND CULTIVATION.

The best soil for vegetables is a fertile, easily worked loam. A very sandy soil is usually poor in plant food, does not hold moisture well in a dry time, and when fertilizers are applied they are rapidly leached out by rains. Heavy clay soils, while they retain moisture and plant food, are difficult to work. In a dry time they are hard and likely to bake and in a wet time are so sticky as to be unworkable. Muck soils, if well handled, are excellent for gardening purposes, though they are generally poor in potash and phosphoric acid. Very little of this type of soil is found in Porto Rico.

Of equal importance with the fertility of the soil is its physical condition. Compact clay soils are usually greatly benefited by incorporating with them some bulky material like stable manure or by plowing under some green crop. This makes the soil more mellow and more easy to work, and the plant food in the soil is made more quickly available to the growing plant. So, too, sandy soils are made more compact and hold moisture and the plant food applied to them

much better if they contain an abundance of humus or bulky material obtained by plowing under a green crop or barnyard manure, or some other kind of vegetable matter.

All soils need frequent cultivation. There are two or three reasons for this. Cultivation loosens up the soil, so that air can penetrate more easily. This helps to make the locked-up plant food in the soil soluble and more readily available to the plant. It keeps down the weeds which compete with the vegetables for plant food, and which, if not controlled, dwarf or choke out the crop. Cultivation also tends to conserve the soil moisture, which is often a very important consideration. In dry weather the water in the soils is constantly rising to the surface in some such manner as oil rises in a wick. At the ground surface the water is evaporated and lost. Evaporation is most rapid on compact soils. When the top soil is cultivated, it forms a kind of loose, dry blanket or mulch which greatly hinders the rapid escape of the moisture from below. Good crops of vegetables have been grown to maturity without rain for three months or even more where regular cultivation was kept up throughout the whole period.

MANURES AND FERTILIZERS.

For successful vegetable growing a fertile soil is essential. If the soil is not naturally fertile, it must be made so by the addition of fertilizers. Of all forms of fertilizers for bringing up poor soil or putting it in condition to grow vegetables nothing surpasses barnyard manure. Should this not be available the land must be improved with composts, green manure, and commercial fertilizers.

All refuse organic material can be cheaply converted into available plant food by composting. The compost heap, consisting of refuse material or manure, or both, should be placed on an incline, with packed clay or cement foundation, with a pit at the lower side to receive the liquid leachings. This should be returned to the heap often enough to keep it constantly moist. While this involves a certain amount of labor and some expense, it pays very well, and it is questionable whether the handling of manure or refuse will pay without it, because in letting the liquid leach away most of the fertilizing value is lost, and in letting the heap dry ferment most of the nitrogen is lost.

The plowing under of a growing crop is known as green manuring. Any vegetable matter worked into the soil improves it physically, as well as chemically, but if grown on the same land the crop will naturally not supply more than it derived from the soil, except humus, if it is not able also to derive some fertilizing element from other sources. Leguminous plants, whether beans and peas or the Royal Ponciana, are able to assimilate the free nitrogen of the air and store it in the plant cells. It is obvious, therefore, that legumes should always be

planted and plowed under for green manuring. Two of the most suitable legumes for Porto Rico are cowpeas and velvet beans. Both respond favorably to a fertilizer containing potash and phosphoric acid, but they are able to take up most of the nitrogen they require from the air, which in nitrogen-poor soil may amount to as much as 200 pounds per acre. This is no inconsiderable gain with nitrogen costing 15 to 20 cents per pound. In addition to these, which may be called home manures, there is a number of more concentrated forms known under the general term of commercial fertilizers.

These commercial fertilizers are seldom of particular value for improving the physical condition of the soil, but are valuable sources of plant food. There are three general classes of these fertilizers: (1) Those that supply nitrogen; (2) those that supply potash; and (3) those that supply phosphoric acid. Plants require many more different kinds of food than these, but these are the plant foods oftenest lacking in the soil. In order to get the greatest benefit from the use of these concentrated and expensive forms of fertilizers, they should be used only on well tilled land and preferably in connection with manure or compost which improves the physical condition of the soil.

In commercial fertilizers the nitrogen is usually derived from nitrate of soda, sulphate of ammonia, dried blood, tankage, or cotton-seed meal. The principal sources of potash are potash salts, mainly muriate and sulphate, and also wood ashes. Phosphoric acid occurs in rock phosphate which is insoluble in its raw state, but becomes available when treated with sulphuric acid. This is also one of the main ingredients of guano, of which there are numerous deposits on the island and which ought to be utilized at least for home use. Phosphoric acid is also largely derived from ground bone which is also treated like rock phosphate. The phosphoric acid contained in a commercial fertilizer is valuable according to the form in which it occurs. Soluble phosphoric acid is worth its market value, but the insoluble form is worth no more, but even less, than the native guano, no matter whether the source is rock phosphate, Thomas slag, or bone. The reverted form, of which a small percentage generally occurs in commercial fertilizers, is insoluble in water, but is available as plant food.

SEEDS AND PLANTING.

NECESSITY FOR GOOD SEED.

The matter of good seed is so vital to successful vegetable growing that it requires especial emphasis. The seed grown on the island is selected for the most part from degenerated stock, and the vegetables grown from it are very poor in quality. Even freshly imported seeds soon lose their vitality in this climate and can not be relied upon. Seed procured from the United States from fresh stocks immediately before planting is the only sure method at present.

SOWING THE SEED.

A certain amount of heat and moisture is always necessary for seed germination. It is variable for the different species, but all the common garden vegetables can be germinated here any time of the year. While moisture is necessary, it is not usually best to sow seeds in rainy weather, because here the rains are so heavy that the seeds are liable to be washed out and a crust formed on the top which is often detrimental to the germinating plant.

For best success in germination the soil should be mellow and moist without being soggy. The seed should be covered to a depth of about twice its own diameter and the soil should then be well firmed. The depth of covering may vary with the kind of soil. In a light soil the young seedling will be better able to force its way through than in heavy clay, hence in such the seeds may be covered deeper. Another reason for sowing deeper in light soil is that it does not retain moisture so well. Firming the soil as advised may seem contrary to good practice, as the firm soil loses moisture quicker than that which is loose on top, but it must be remembered the seeds are sown in the top soil, which must be kept moist until germination has taken place. After that, when the roots are able to absorb moisture from the deeper soil, the top crust should be broken up.

THE SEED BED.

Several vegetables do not succeed well when transplanted and must therefore be sown in the field; others succeed equally well sown in the field or transplanted, and others again must be germinated in a seed bed in order to succeed. The grower must decide in each case which method should be used. If the seed is cheap and labor expensive, sowing in the field will be cheapest, all other conditions being equal, but if the weather is very dry or if very heavy rains can be expected any time the seed-bed method will be the best. If the soil is infested with changa or cutworms, it will often be advantageous to sow in the field, because, while those pests would destroy all the plants if set 1 to 4 feet apart, they will usually leave enough when the plants stand close together.

Certain vegetables must necessarily be sown in seed beds, because the seeds are so small and germinate so slowly that when sown in the open they are usually killed out by weeds, heavy rains, or droughts. The soil in the seed bed should preferably be light and mellow. The bed should be located near a plentiful water supply and covered with material which will break the force of heavy rains and prevent drying out. For the home garden, with a small seed bed, a covering of palm leaves will answer the purpose; a layer of chopped moss or fine chopped grass spread over the top of the bed is also beneficial, but for large seed beds a covering of plant cloth is far the best. This is stretched over three wires, one on each side about 12 inches high and one in the

middle 20 to 30 inches higher (Pl. I, fig. 1). The cloth should be removed gradually and not left long enough to induce a spindling growth.

SEED BOXES.

The soil in the home garden especially is often infested with ants, which prey on several kinds of seeds. These can be overcome by sowing in boxes raised a foot or more from the ground and having the legs wound with cloth soaked in kerosene. The cloths should be resoaked two or three times a week to prevent the ants from entering. Seed boxes can be made cheaply, as they need to be only a few inches deep, with cracks or holes in the bottom for the sake of drainage (Pl. II, fig. 1). They may be placed under trees or in some shady place, and will need but little attention aside from watering.

PRICKING OUT.

More seeds are always sown in a seed bed than the ground will accommodate after germination. If all are left to grow the plants will develop spindling tops and poor root systems. Some of the plants may be thinned out in order to give the others room,or all of the plants may be taken up while very small and planted into a new bed where they are set at a distance suitable to their size. If this process, called pricking out, is performed in the afternoon or evening and the ground is kept moist, the plants will suffer no setback and will often develop better root systems than if left in the original bed.

TRANSPLANTING.

It is well known that plants wilt when removed from the soil. The reason for this is that transpiration continues from the leaves while no moisture is taken up by the roots. This can partly be checked by removing some of the top and by keeping the roots moist. It is also well known that plants wilt less in cloudy and rainy weather than on dry hot sunshiny days. This is because when the air is as moist as the soil and the plants little evaporation takes place, while when the air is drier the soil dries out by evaporation and the plants wilt because of transpiring more moisture than the roots are able to supply. For transplanting, a cloudy or rainy day should therefore be selected. The plants should be taken up without injuring the roots and placed in a basket with the roots in one direction. The basket should be covered with a cloth, and in addition to that the roots may be wrapped with wet moss or some similar material. Another good method to check wilting is to dip or puddle the roots in clay stirred up in water to the consistency of sirup, which protects the young fibrous roots from drying out. The plants should be set in the field at the same depth at which they stood in the seed bed. The plant holes may be made with any suitable instrument, always deep enough to accommodate the roots without bending and doubling, but never so deep as to leave a hollow space underneath.

FIG. 1.—SEED BEDS COVERED WITH CLOTH.

FIG. 2.—METHODS OF PACKING TOMATOES, EGGPLANTS, AND PEPPERS.

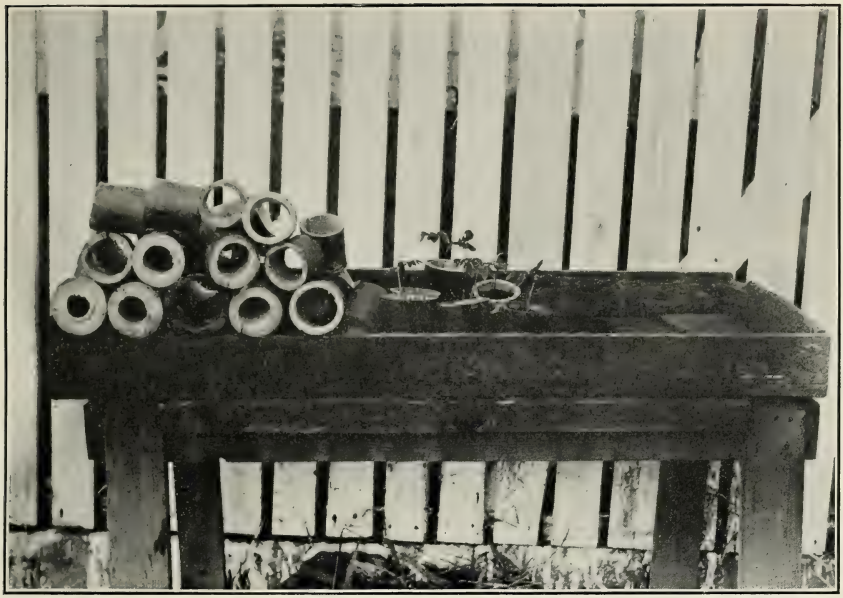

FIG. 1.—SEED BOX AND BAMBOO POTS.

FIG. 2.—BEETS, SHOWING VARIETIES.

1, Bassano; 2, Electric; 3, Crimson Globe; 4, Egyptian; 5, Half Long Blood.

NUMBER OF PLANTS PER ACRE.

One acre contains 43,560 square feet, or, in other words, a square with sides 208 feet 8½ inches long is an acre. One cuerda contains a little less—42,307 square feet. The following table shows the number of plants required per acre with different distances between plants and rows.

Plants required per acre at different distances.

Distance between the rows.	Distance between plants in the row.	Number of plants required to the acre.	Distance between the rows.	Distance between plants in the row.	Number of plants required to the acre.
Ft. In.	*Ft. In.*		*Ft. In.*	*Ft. In.*	
0 6	0 6	174,240	3 0	1 0	14,520
0 7	0 7	128,013	3 0	1 6	9,680
0 8	0 8	98,010	3 0	2 0	7,260
1 0	0 1	522,720	3 0	2 6	5,808
1 0	0 6	87,120	3 0	3 0	4,840
1 0	1 0	43,560	4 0	0 6	21,780
1 6	0 1	348,480	4 0	0 9	14,520
1 6	0 6	58,080	4 0	1 0	10,890
1 6	1 0	29,040	4 0	1 6	7,260
1 6	1 6	19,360	4 0	2 0	5,445
2 0	0 3	87,120	4 0	2 6	4,356
2 0	0 6	43,560	4 0	3 0	3,630
2 0	1 0	21,780	4 0	3 6	3,111
2 0	1 6	14,520	4 0	4 0	2,722
2 0	2 0	10,890	5 0	5 0	1,742
3 0	0 6	29,066	6 0	5 0	1,452
3 0	0 9	19,360	6 0	6 0	1,210

ENEMIES OF PLANTS.

After the gardener has succeeded in putting his land into the best possible condition and in securing a good stand of plants some plant disease or insect enemy may invade the field and destroy the whole crop within a day or a week. The vegetable grower must, therefore, know not only how to plant and grow crops, but also how to protect them against their enemies. If the season is wet, plant diseases caused by fungi or bacteria are liable to be especially abundant; if it is dry, insect enemies are unusually numerous. It is desirable, therefore, to understand in a general way the nature of these two great classes of enemies, and the general principles involved in their control.

PLANT DISEASES.

Plants may become diseased as the result of unfavorable weather or soil conditions, or as the result of insect or fungus attacks. Only the diseases caused by fungi are considered here.

FUNGI.

Fungi are low forms of plants. They live entirely on other plants or on dead organic matter. When fungi develop on plants, they appropriate the food that the plant makes for itself to their own use, thus sapping the life of the plant and greatly weakening or even killing it. Fungi are propagated by microscopic bodies called spores, which correspond to seed in the higher plants. These spores are produced by

millions and are blown about by the air and carried by water, insects, and other agents everywhere. When they find suitable lodging places, as on the leaves, stems, roots, flowers, or fruits of plants, and conditions are favorable they germinate and grow, to the injury of the plant on which they develop.

In combating fungus diseases, the aim of the gardener is to prevent the disease rather than to wait and try to cure the plant after it has become affected. This is done by spraying the plants with some substance that will kill the spores of the fungus before they germinate and become established on the plant. Successful gardeners spray their plants at the first indication of disease, and in localities where certain diseases may be expected spraying is often done even before there is any appearance of disease as a matter of precaution or insurance.

FUNGICIDES.

Remedies used for the control of fungus diseases are called fungicides. The most effective fungicides are made from compounds of copper. Mixtures containing sulphur as a base are also frequently used, and they give good results with certain diseases, like powdery mildew.

Bordeaux mixture.—The fungicide of most general usefulness is that known as Bordeaux mixture. The formulas for making Bordeaux mixture and several other fungicides which are referred to in the description of vegetables in this bulletin are given below.[a]

Copper sulphate (bluestone)	pounds	6
Stone lime (not air-slaked)	do	4
Water	gallons	50

The principal active property in this mixture is the copper sulphate. The lime acts as a neutralizer and makes the mixture more adhesive, while the water acts as a carrier for the other materials. The copper sulphate can be bought in quantities and kept on hand without deteriorating, but the stone lime will air slake very quickly in this damp climate, and should therefore be brought fresh from the kiln every time before using, or, better, a large quantity may be slaked in a barrel sunk in the ground, where it will keep for a long time if covered. To slake lime so as to make it most adhesive, place it in a receptacle and add water little by little, enough to prevent it from air slaking or powdering, but not enough to submerge it, because in that case some of it remains unslaked.

To make Bordeaux mixture, place the copper sulphate in a coarse sack and hang it in a receptacle containing 25 gallons of water and leave it until dissolved. In another receptacle stir up about 10 pounds of the previously slaked lime in 25 gallons of water and strain it. Pour the two solutions simultaneously into a 50-gallon barrel, under constant stirring. It is then ready for use. Bordeaux mixture should

[a] See also U. S. Dept. Agr., Farmers' Buls. 127, 146, and 243.

always be used immediately or within a few hours after making, as it loses its adhesiveness by standing. The mixture can be safely used on tomatoes, potatoes, beans, etc., but for cucumbers it is necessary to furthur dilute it by using 75 to 100 gallons of water.

It is very important that this mixture shall not contain an excess of copper sulphate, because it will then injure the plants. It is therefore advisable to test[a] the mixture before applying it to tender foliage. Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, U. S. Department of Agriculture, has suggested two very simple tests, which are as follows:

(1) Insert the blade of a penknife in the mixture, allowing it to remain there for at least one minute. If metallic copper forms on the blade, or, in other words, if the polished surface of the steel assumes the color of copperplate, the mixture is unsafe and more lime must be added. If, on the other hand, the blade of the knife remains unchanged, it is safe to conclude that the mixture is as perfect as it can be made.

(2) As an additional test, however, some of the mixture may be poured into an old plate or saucer, and while held between the eyes and the light the breath should be gently blown upon the liquid for at least half a minute. If the mixture is properly made, a thin pellicle, looking like oil on water, will begin to form on the surface of the liquid. If no pellicle forms, more milk of lime should be added.

Ammoniacal carbonate of copper.—This fungicide may be prepared by the following formula:

Copper carbonate	ounces	5
Ammonia (strength 26° Beaumé)	pints	3
Water	gallons	50

The ammonia of 26° strength is not the common grade obtainable in grocery stores, but the stronger grade handled by drug stores. In making the mixture the ammonia should be diluted with 3 gallons of water in a wooden vessel, and the copper carbonate, in powdered form, should be tied up in a thin cloth and stirred around in the liquid until dissolved. Very often the ammonia is unable to dissolve all of the powder, but if a residue remains after ten to fifteen minutes' stirring it may be kept until next time of making. On the other hand, if all dissolves, another small amount should be tied up in the cloth and stirred in the liquid at least five minutes. This mixture may be kept in glass bottles without deteriorating if well corked. For use 1 part of this should be mixed with 15 parts of water.

The copper in this mixture is in a soluble form and when applied to plants it does not stain, which is an advantage over Bordeaux mixture

[a] The simple tests given will usually be found to answer the purpose. The following is an excellent chemical test for those who wish to attempt its application: Take an ounce of ferrocyanid of potassium (a very poisonous substance, which must be handled with care) and dissolve it in 4 or 5 ounces of water. Take about an ounce of the Bordeaux mixture in a glass or saucer and add 2 drops of the original copper sulphate solution in order to have the sample contain more of that than the mixture. The test consists in dropping one drop of the ferrocyanid solution into the sample and noting the color produced. If the drop striking becomes slightly yellow, the mixture is safe to apply to plants; but if it turns a bright-red color, more lime must be added.

when spraying ripening fruit. The mixture can be used everywhere, like Bordeaux mixture and is about as cheap, but it does not adhere so well in rainy weather.

Lime-sulphur mixture.—This mixture may be made as follows:

Sulphur (powdered)	pounds	3
Lime (unslaked)	do	3
Water	gallons	6

These ingredients should be boiled down to 2 gallons, after which the mixture should be allowed to settle and the clear liquid drawn off. This should be tightly corked up if it is to be kept for sometime, and for use it should be diluted with water at the rate of 1 part of the mixture to 50 of water.

INSECT ENEMIES.

BITING AND SUCKING INSECTS.

From a horticultural standpoint the predaceous insects may be divided into two groups, viz, biting and sucking. The biting insects are those that eat the leaves or other tender parts of the plant, while the sucking insects obtain their food by sucking juices of the living plant tissues. In treating the two classes of insects it should be remembered that only the biting insects can be destroyed by poisons which are taken into the stomach. When a leaf, for instance, is sprayed with Paris green, an insect of the sucking group will obtain but a very minute part of that poison by penetrating it with its sucking mouth parts, while the biting insect will readily eat enough of the poisoned leaf to kill it. Sucking insects can be destroyed by applying mixtures which kill by penetration or which are sticky enough to stop up the breathing pores or adhesive enough to prevent motion.

ARSENICAL INSECTICIDES.

A remedy for the control of insects is known as an insecticide. The various kinds of insecticides may be classed under stomach poisons and contact remedies. The poisons commonly used are arsenical compounds, of which Paris green and arsenate of lead are of most importance to the vegetable grower.[a]

Paris green.—This is a green powder, which should contain not less than 50 per cent of arsenic. It may be used dry and should then be mixed with air-slaked lime or flour to make it adhere better. It may be applied together with any of the liquid sprays at the rate of 1 pound per 100 gallons of water; also in water alone at the same rate, in which case it should be mixed with at least 2 pounds of quicklime, and the mixture should be kept well stirred up while spraying. Paris green is insoluble in water, but may be dissolved in ammonia. This is a

[a] For particulars see U. S. Dept. Agr., Farmers' Bul. 127, copies of which are for free general distribution.

good test for adulteration, because the adulterants of Paris green are not usually soluble in ammonia. When using Paris green, either as a dust or a liquid spray, it is safest to mix it with air-slaked lime, because otherwise it is liable to injure the foliage.

Arsenate of lead.—This can be used in the same manner as Paris green, and it has the advantage of being harmless to the foliage and can be applied at any strength. It also adheres to the foliage without being mixed with other materials.

Poisoned bait.—For changas and cutworms mix 1 ounce Paris green or white arsenic with wheat bran or corn meal, moisten the mixture with sweetened water, and distribute it through the field, placing a small amount every few feet and partly covering it with soil.

CONTACT REMEDIES.

Of those which kill by penetration, tobacco decoction and kerosene emulsion are the ones most commonly used by gardeners. Kerosene emulsion, resin compound, and whale-oil soap or common washing soap are used as adhesives.

Tobacco decoction.—Steep tobacco stems for several hours in sufficient water to cover them. Strain the resulting liquid and dilute with water to the color of strong tea.

Kerosene emulsion.—The formula for kerosene emulsion is as follows:

Soap	pound	¼
Water	gallon	½
Kerosene	do	1

Dissolve the soap in hot water and add the kerosene. Then with a spray pump emulsify the mixture by pumping it from the receptacle and back again, continuing from five to ten minutes or until no free kerosene appears on the top. This will keep in good condition for a long time, and for use should be diluted with 10 parts of water.

Resin compound.—This compound may be made as follows:

Resin	pounds	4
Sal soda	do	2
Water	gallons	2½

Place the resin, sal soda, and 1 pint water in a kettle and boil while stirring constantly until all is melted together. Then gradually add the rest of the water under continued boiling. This mixture should be strained and may then be kept as a stock solution. It contains 2 pounds of a very adhesive mixture per gallon and may be diluted with 5 to 10 parts of water according to the insects to be treated. This mixture is more adhesive than others and also cheaper.

Whale-oil soap.—Soaps, either common washing soap or whale oil, will dissolve in boiling water at the rate of 2 pounds to the gallon, and will keep in a liquid state if the water is not allowed to evaporate. For use dilute with water as directed for the resin compound.

SPRAYING APPARATUS.

The requirements of a spray pump are that it must be of simple construction, all its parts must be strong, and the ones which come in contact with the liquid must be of brass or brass lined. The simplest and at the same time one of the most efficient pumps is the bucket pump in its most improved form, and one of these ought to be in the possession of every gardener. For the home garden the bucket pump (fig. 1) answers all the purposes, but for the market garden, containing

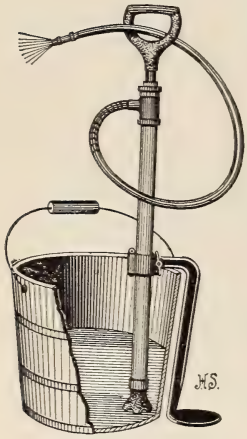

FIG. 1.—Hand bucket spray pump. For convenient use a longer hose than that shown is needed.

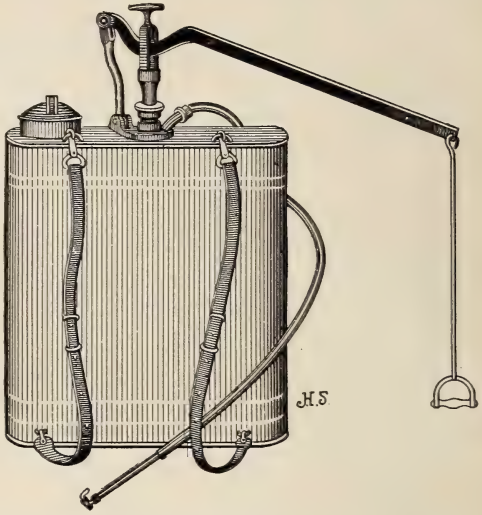

FIG. 2.—Knapsack sprayer. The handle can be removed and the tank carried in the hand instead of on the back, if desired.

2 to 3 acres, it may be necessary to secure a knapsack pump (fig. 2), by which a larger area can be sprayed, because no time is lost in moving it about. The barrel sprayer is a force pump mounted on a barrel, which may be moved by hand or horse power; it is usually very efficient and several acres can be sprayed with it in one day.

DETAILED CULTURAL DIRECTIONS.

While it has been fully demonstrated that vegetables can be successfully grown in Porto Rico, it will require but a short trial to convince the inexperienced that for him there are more failures than successes. He should not forget, however, that valuable experience is gained through adverse conditions, although it may be costly.

The following cultural directions, it is hoped, will serve as a guide to the inexperienced vegetable grower, so that he may be spared both time and money in acquiring a knowledge of successful vegetable growing.

ASPARAGUS.

While it has not been thoroughly demonstrated that this vegetable can be grown successfully in Porto Rico there seems to be no reason why it could not. It will survive in nearly all kinds of soil and under all kinds of mismanagement, but will produce no edible sprouts unless well manured and cultivated. It is possible that most farmers in Porto Rico would be able to grow it on a small scale, but for commercial growing the land selected should be a well-drained clay or peat loam or a pure peat or muck, which must be either naturally moist or else capable of irrigation. Most vegetables require rich soil though there is always a limit, but in asparagus growing it is almost impossible to apply too much stable manure; and, unless the soil is very rich, a generous amount should be applied and the ground worked deep.

SOWING THE SEED.

The seed should be sown in December or January in an ordinary seed bed, in rows 18 inches apart. If the bed is kept moist, the seeds will germinate in four to six weeks and will make tops 5 to 6 feet high in the course of six months. The beds should be kept free from weeds, and if the soil is mellow and rich the roots will be large and in good condition for transplanting by fall.

PLANTING AND CULTIVATION.

In the fall when the roots are 1 year old rows should be marked off 4 feet apart and furrowed out to a depth of 8 to 10 inches, after which the soil in the bottom of the furrow should be loosened as deep as practicable. The roots should be set in the bottom of the furrow at a distance of 2 feet apart and the furrow filled with soil. As soon as the tips show through the soil so as to outline the rows, the soil should be cultivated and kept free from weeds. The following December, a year from planting, the tops should be cut off close to the ground and the soil ridged up over the rows to a height of 4 to 6 inches.

HARVESTING.

In January the sprouts will be coming through the top and sides of the ridges and should be cut when about 6 inches high, cutting about 2 inches below the surface. The product will be green sprouts. If blanched sprouts are preferred, they should be cut as soon as the tips show above ground. This is done with a special knife, but a machete would make a fair substitute. The blade should be inserted to a depth of 8 inches close to the sprout, which is then cut off with a sudden twist of the knife. This operation should always be performed with some care, so as not to injure the crown of the plant or any of the young shoots just forming. Cutting may be continued for 6 to 10 weeks, after which the tops should be allowed to grow in order to make strong roots for next season. In favorable localities, like

some places in California, the beds are continued for twenty years or more without replanting, and yield from 5,000 to 8,000 pounds per acre annually. This is, however, in very rich muck land such as is not to be found in Porto Rico.

MARKETING.

After cutting, the sprouts should be washed and tied in bunches of $1\frac{1}{4}$ to $2\frac{1}{2}$ pounds, according to the market requirements. The Boston market requires green sprouts in $1\frac{1}{4}$-pound bunches, and New York, blanched sprouts in $2\frac{1}{2}$-pound bunches. The bunching is generally done in a buncher, which can be obtained from implement dealers. The tips are placed even with each other and the butts are cut off square at a uniform length, 7 inches being most acceptable. The bunches are packed in bulk, in crates holding two tiers, or one-half crates, holding only one tier, by placing the bunches, butt end down. In shipping, the crates are placed right side up and sent in refrigerated compartments.

VARIETIES AND DISEASES.

The most common varieties in the States are: Conover, Colossal, Palmetto, Columbian, and Mammoth. The Palmetto is probably the most vigorous and has also proved to be more rust resistant than any of the others, but it is coarser, especially when a couple of days too old.

The most dreaded disease is asparagus rust (*Puccinia asparagi*), a fungus disease of the leaves and stalks, which can be kept in check with applications of Bordeaux mixture combined with resin compound or by the use of dry sulphur.

BEANS.

A few varieties of beans are grown successfully in Porto Rico, showing that they are adapted to the country, but the quantity grown is not nearly equal to the demand, and large importations are made from Europe and the United States. Beans are not very fastidious as to soil, although a well-drained loam is the most suitable. The amount and kind of fertilizer to be used will vary with the class of soil; most of the soils in Porto Rico would be benefited by stable manure. If a commercial fertilizer is used, the nitrogen may be less than in the usual formulas, but although the bean is a legume, it should not be eliminated altogether, because a small amount of available nitrogen enables the crop to start growth and forces the plant until the root nodules can be formed and a supply gathered from the air.

VARIETIES.

All the varieties may be roughly classed under bush and pole beans. The first named is usually divided into Green podded, Wax, Lima, and Broad or English, and the same distinctions might as well be used

for the running varieties also. The varieties most commonly grown in Porto Rico are of the green-bush type, a Lima bean resembling the Small Sieva is also grown, but very sparingly. In the States the bush beans are planted most extensively for "snaps," but the varieties found for sale in the markets here are much inferior for snap beans. They are very good for dry beans, however, and as they are well acclimated, they may be planted for that purpose. Experiments at this station showed the green-podded varieties to be more disease resistant than the wax, and the following varieties gave best results: Bountiful, Long Six Weeks, Round Six Weeks, and Giant Podded Valentine. Of the bush wax the following varieties gave the best results: Improved Black Wax, Burpee Saddleback, and Currie Rust Proof. In regard to the bush Lima beans, the most vigorous and robust varieties should be planted as they are more disease resistant and in Porto Rico the time of ripening is of no importance. The pole beans are usually vigorous and could be recommended for general culture if it were not for the expense of staking. They are very acceptable for home use where only a small amount is planted. The following varieties gave indications of being well adapted to the conditions at the experiment station, viz: Feast Bean from Curacao, Southern Prolific, Golden Carmine Podded, Black Wax, and Small Sieva Lima. A native white bean was also very promising, but that will probably have to be grown a few seasons in order to make it a staple variety.

PLANTING AND CULTIVATION.

Beans may be planted any time of the year, but as they are much more subject to diseases in seasons with an overabundance of rain it is desirable to plant so as to have them mature when it is reasonably dry. On well-drained sandy soil flat culture is preferable. On heavy moist clay soil the land should be ridged up in rows 3 feet apart and the beans planted at a distance of 4 to 6 inches in the row. The crop should be kept clean with a cultivator or hoe until blooming time, after which cultivation should be stopped, so as not to injure the plants.

HARVESTING AND MARKETING.

Snap or string beans is the name given to the pods when the beans are about half grown and before the pods become tough. The pods should break off with a snap and not bend or tear. In that condition the beans are highly prized and bring good returns in the northern markets any time between December and May. The pods should be picked while dry and left in the sun just long enough to lose their brittleness, after which they should be packed in crates. In packing, all the small, injured, or deformed pods should be discarded and the good pods straightened out and placed in the crates so as to make a neat appearance. Snap beans will stand shipment

to New York even on our slow steamers, but refrigerator compartments will be necessary. For dry beans the pods should be left until the beans are ripe; the vines can then be cut and thrashed when thoroughly dry. The growing of dry beans for home consumption will no doubt pay, but probably not for export.

DISEASES AND INSECTS.

With the limited data at hand it would be too early to predict which of the common diseases will be troublesome here, or if any new ones will appear. In the experiment plats a root disease, not determined, did some damage, but it is believed to do so in wet soil only. A fungus (*Cercospora* sp.) which appeared on the leaves can be controlled with Bordeaux mixture. This same remedy may also be used for mildew (*Phytophthora phaseoli*), a fungus disease on Lima beans, which has been sent in to the station from various places on the island. Insect pests did very little damage at the station this year, but the cotton-boll worm may be expected as a serious enemy in some sections.[a]

BEETS.

This vegetable is not commonly grown in Porto Rico. A few specimens may be found in the markets from time to time, but they are invariably small and of inferior quality. It was thoroughly demonstrated at this station that beets could be grown very successfully any time of the year, and the inferiority of those found in the markets must be ascribed largely to inferior seed, and probably also to improper treatment. Beets thrive best in a rather heavy moist soil and require a fertilizer containing an abundance of potash. If the soil is not well drained and lime can be had cheap, it will pay to apply a liberal amount of that; and in places where salt is cheap enough it will often pay to apply 200 to 300 pounds of that also. A well-drained salt-marsh land will grow beets to perfection without either fertilizer, lime, or salt.

VARIETIES.

Most of the common varieties were tried at the station (Pl. II, fig. 2), and the following can be recommended for general planting: Extra Early Electric, Extra Early Egyptian, Extra Early Eclipse, Edmand Blood, and Bassano. The sugar beets, Kleinwanzlebener and Vilmorin Improved, were also tried and gave fairly good results as to yield. As a table beet they were almost equal to the best, but when selling in the market people did not take readily to them on account of the white color.

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[a] Information in regard to this insect is given in U. S. Dept. Agr., Farmers' Bul. 212, which may be had on application to the Secretary of Agriculture.

PLANTING AND CULTIVATION.

The seeds are sometimes slow to germinate, and for the home garden it is well to soak them a few hours in lukewarm water. In field culture, where a drill is to be used, this is not practical. Sow the seeds in rows 18 inches to 2 feet apart, and when the young plants are well established thin them out, leaving the individual plants 4 to 6 inches apart. In moist soil the cultivation consists in keeping the weeds down, which will often have to be done by hand. In lighter soil it is always cheaper to use a cultivator.

HARVESTING AND MARKETING.

For the home market the beets may be pulled any time after attaining a diameter of 1½ to 2 inches, tied in bunches without removing the tops, and sold as "bunch beets." This would pay on a small scale near a large town, as beets are generally liked by both Porto Ricans and Americans. For long-distance shipment the roots should be well formed and of good size. The tops should be cut off, so as to leave about one-half inch of the leaf stems, and after drying in the sun about an hour the roots may be packed in ordinary vegetable crates. They should be able to stand shipment to New York without cold storage, but it should be remembered that beets are not a high-paying crop, and shipment should not be attempted unless the market quotations warrant it.

BRUSSELS SPROUTS.

This vegetable is far superior to cabbage from the standpoint of quality. Experiments at this station indicate that it is difficult to grow successfully in Porto Rico, and should therefore be tried on a small scale only. For cultivation, marketing, and dealing with enemies, follow the same directions as are given under "Cabbage."

CABBAGE.

This vegetable is grown to some extent on the island, but is nearly always inferior in size and quality. It sells at a high price, however, because imported cabbage costs 8 to 10 cents per pound. The scarcity would to some extent indicate the difficulty of production, but that criterion can not always be relied upon in Porto Rico; as a matter of fact, enough cabbages can be grown on the island to supply the demand and can be sold at a profit at 3 cents per pound.

In general, the best soil for cabbage may be described as a rather moist, well-drained, rich loam, and this holds good for Porto Rico, but an excess of moisture and richness are likely to favor the spread of black rot. The locality has also some influence, for in some sections the ravages of the cabbage worm, especially after the second crop, will be such as to make further culture impossible. The recom-

mendations should, therefore, be: A well-drained loam, capable of irrigation, located in a mountain district where there are not many wild plants belonging to the cabbage family, and where the cabbage worm does not occur abundantly.

For fertilizer, stable manure is very good, but to prevent black rot and club root it would be advisable to apply a commercial fertilizer containing about 3½ per cent nitrogen, 6 per cent potash, and 5 per cent phosphoric acid. As to the best time for planting, the rainfall should be considered more than the temperature; always choose the drier season, unless situated in a dry locality, like Lajas or Yauco.

VARIETIES.

The earlier varieties, such as Early Jersey Wakefield and Early Winningstadt, mature in the North in 90 to 100 days from seed; at this station those varieties have matured in 75 to 80 days, and for the later varieties the time is proportionally shorter. The above-named varieties are generally considered better adapted to this climate than the flat-head varieties, but experiments at this station did not support this opinion, and all good heading varieties, such as Early Spring, Early Summer, Surehead, Allhead, and Savoy, can be planted here, and probably the very large winter varieties of the Drumhead type also, but they can not always be relied upon as sure headers in this climate.

PLANTING AND CULTIVATION.

Seeds should be sown in seed beds and seed boxes and the plants pricked out when very young to a distance of 2 to 3 inches apart, or else the surplus plants should be cut out, leaving the remaining ones 2 to 3 inches apart in order to make them grow stocky. If the seed-bed soil is rich, the plants will be ready for transplanting in 3 to 4 weeks. The smaller varieties may be planted in rows 2½ feet apart, with 18 inches between the plants. Plants of larger varieties should be set at intervals of 2 to 2½ feet in rows 3 to 3½ feet apart.

Choose a cloudy or rainy day for transplanting. Remove the plants from the seed bed with as much soil as possible, so as not to injure the roots. Place in a covered basket and sprinkle with water to prevent drying out. To plant in the field, make a hole with a dibble or round pointed stick, and insert the plant somewhat deeper than it was in the seed bed and press the soil firmly around the roots. In dry soil cultivation should be frequent, in order to preserve the moisture; in heavier and moister land it should also be frequent, in order to aerate the soil.

HARVESTING AND MARKETING.

Under favorable conditions the cabbage makes a firmer but somewhat smaller head when grown in the Tropics than when grown in a colder climate; and, as it grows faster and matures in a shorter time,

FIG. 1.—CARROTS SHOWING STUMP-ROOTED, HALF LONG, AND LONG VARIETIES.

FIG. 2.—CHAYOTE VINE AND FRUIT.

it is usually crisper and of superior flavor. For home use or for home market, the heads can be cut any time. For shipping to a distant market they should be left until fully matured, gathered when dry, the stalk cut off even with the head and the outer leaves removed, after which they may be packed in barrels or one-half barrel crates.

DISEASES AND INSECTS.

The bacterial black rot (*Pseudomonas campestris*) is liable to be one of the worst diseases of cabbage here. Infection takes place through any abrasion in the leaves or stem, such as may be caused by insects, and no remedy has so far been found. As means of prevention, it is advised to plant on well-drained soil and to keep the insects in check.

Club root (*Plasmodiophora brassicæ*), a disease which makes large club-shaped swellings on the roots, may also be troublesome here, although it did not appear in the station experiment plats. A large application of air-slaked lime is beneficial, but it is far better to avoid planting in infected land.

Downy mildew (*Peronospora parasitica*) and leaf blight (*Macrosporium brassicæ*), diseases which attack the leaves, may be kept in check by spraying with Bordeaux mixture containing about 5 gallons of the resin compound.

Of insects, the cabbage worms, of which there are several species, will no doubt be the most difficult to control, because of their great numbers. They are easy to find, but when they appear in large numbers eternal vigilance will be the price of good cabbage. The remedies are cultural methods and poisons, such as Paris green mixed with air-slaked lime or flour, or arsenate of lead mixed with resin soap. Contact remedies such as kerosene emulsion can also be used to good advantage.[a]

CARROTS.

This vegetable can be grown to perfection in Porto Rico almost any time of the year. (Pl. III, fig. 1.) It prefers a rich loam and grows very well on a heavy clay which is not too wet, but a light sandy soil is not well adapted to it. For fertilizer, stable manure will do when nothing else is available, but a commercial fertilizer, rich in potash and phosphoric acid, is much to be preferred for this crop.

PLANTING AND CULTIVATION.

The stump-rooted varieties, such as Oxheart, Early Scarlet Horn, and Half Long Danvers, are preferable for table use, and they also succeed better here than the long varieties. The seeds should be sown in drills about 18 inches apart, and after the plants are well up they

[a] For further information, see U. S. Dept. Agr., Bureau of Entomology Circ. 60, which may be had on application to the Secretary of Agriculture.

should be thinned out to 2 to 3 inches in the row. This as well as some of the weeding often has to be done by hand; but when carrots are grown on a commercial scale much of the work can be done with either a hand or horse cultivator.

HARVESTING AND MARKETING.

Carrots are seldom grown extensively for a long-distance market, but they often bring good prices in the early spring and might be profitably grown here for shipment to the Northern States whenever the prices warrant it. Harvesting is usually done by hand and is facilitated by loosening the soil on one side of the row close to the roots. The carrots should be washed and some of the leaves trimmed off, after which they are tied in bunches and left a little while to dry. The ordinary vegetable crate is suitable to ship in and refrigeration is not necessary.

CAULIFLOWER.

While this vegetable gave negative results when grown at this station it may possibly succeed under more favorable conditions, though it is not probable that it will ever be grown extensively in Porto Rico. The soil requirements, planting, and cultivation are practically the same as for cabbage. For diseases and insects, see "Cabbage" (p. 27).

CELERY.

This vegetable is not commonly grown in Porto Rico, neither is it commonly used. The natives as well as many of the Europeans use it for soup flavoring only and the blanched product is almost unknown. Celery has been reported as growing very readily in the mountain districts near Aguas Buenas, and the experiments at this station showed that it can be grown to perfection here. Irrigation facilities and a thorough knowledge of the conditions of growth are the first and main requirements for successful celery culture. A very rich soil is strictly necessary, but if not naturally rich it can be made so by applying a very liberal quantity of stable manure and potash. If the soil is a muck or heavy loam, a commercial fertilizer containing 5 per cent nitrogen, 8 per cent potash, and 6 per cent phosphoric acid applied at the rate of 1 ton per acre will give good results. The soil may be moist enough to make irrigation unnecessary, but such soils are liable to be sour and in bad physical condition. Again, the rainfall may be constant and plentiful enough to grow a crop of celery, but under such conditions it will be found very difficult to blanch it and keep it free from disease.

SOWING THE SEED.

Sow celery seeds in an ordinary seed bed or seed box covered with plant cloth, and, if the weather is very dry, cover the bed with some

fine chopped moss or even old sacking in order to retain the moisture. The seeds may be three weeks in germinating, and watering should be strictly attended to. After the plants are well up they should be thinned to about 2 inches apart and those removed may be transplanted to another bed, and all will be ready for planting in the field in eight to ten weeks, at which time they should be 4 to 6 inches high.

CULTURAL METHODS.

There are several methods of celery growing, all with reference to the process of blanching. The trench culture where the plants are set in trenches 6 to 10 inches deep is not suited to Porto Rican conditions. Level culture and blanching with earth are not commendable here, but may be necessary on account of the price of lumber. Blanching with boards or draintiles was tried at the station and gave good results. The close culture and the so-called new culture were also tried but with less success.

In trench culture the rows are laid off 3 to 4 feet apart and trenches are dug to a depth of 6 to 10 inches, in the bottom of which the plants are set 6 to 8 inches apart, according to variety. After they have attained a size of 8 to 10 inches, the soil is gradually filled in around the plants until the trench is full, and as the plants grow larger the earth is banked up on both sides of the rows, leaving only the tops of the plants exposed to the light.

The plants may also be set in rows 4 to 5 feet apart on the level instead of in trenches and banked up with earth, or at a distance of 18 inches apart and blanched by placing a 12-inch board on each side of the row. That, however, will not be high enough except for the smaller varieties. Draintiles 7 inches in diameter and 24 inches long are far the best in this climate as they do not rot and can be used over and over again. When either of the two last methods is used, an irrigation ditch should be dug in every third space between the rows.

In the method called "new celery culture" the beds may be laid off $3\frac{1}{2}$ feet wide with irrigation ditches 18 inches wide between the beds. The plants may then be set at a distance of 6 inches apart each way, making five rows to the bed with a margin of 9 inches on each side. In blanching, a wide board is placed on each side of the bed close to the outside rows and secured with stakes in the ground or crosspieces nailed from one to the other. This method can not be used successfully for any but the self-blanching varieties, the stalks of which are able to blanch with the amount of shade afforded by the leaves. In order to make this method a success the land must be very rich and an abundance of irrigation water must be available whenever needed. It may sometimes be necessary to partly cover the beds with palm leaves or some similar material the last week before harvesting in order to give the final blanching.

CULTIVATION AND IRRIGATION.

For growing celery the land must be in good tilth and free from weeds, especially when close planting is practiced, and weeding will have to be done more or less by hand. Irrigation is the all-important feature. The land should be irrigated through furrows where the water should be left long enough to thoroughly moisten from each side to the middle of the bed, but not long enough to make the soil soggy. The number of times to irrigate will depend entirely on the character of the soil and the amount of rainfall and should be judged by the grower in each case.

VARIETIES.

It will require more experiments to determine which is the best variety as well as which is the best method of planting in Porto Rico. The self-blanching varieties can be recommended, and the Boston Market, White Plume, and Giant Pascal should also be tried. As to the time of planting, nothing has yet been determined, except that the fall and winter plantings gave good results at this station.

HARVESTING AND MARKETING.

Celery does not ripen, properly speaking. It is ready for use whenever it is large enough and well blanched. It should not be left in the ground longer than necessary, because it becomes tough and pithy as its gets older, and in this climate especially when left long it throws out an abundance of auxiliary plantlets which do not reach a marketable size and can not be left adhering, as they spoil the appearance of an otherwise first-class plant. This tendency to multiply is much worse in some varieties than in others. When grown for home use, the main plants may be removed and some of the smaller ones left to form a second crop. The outer leaves of the main plant may also be removed, leaving the heart, which will again form a new plant; in fact, this process can probably be continued for sometime, as the celery plant is perennial here.

For marketing, the plants should be dug and the roots trimmed off close. The outer stalks should also be removed if broken or mutilated, after which the plants should be well washed and rinsed. Four to six dozen may be packed in a standard flat 8 by 22 by 27 inches in size. These should be shipped in refrigerator compartments.

Celery is a very profitable crop, and will no doubt be found to be so in Porto Rico. Practical experience, however, is necessary to make a man a successful celery grower.

DISEASES.

The common diseases, such as blight, leaf spot, and rust, may occur here, and, if so, all the affected plants should be pulled up and burned, and the rest should be promptly treated with Bordeaux mixture. Land infested with root knot should not be planted.

CHARD.

This vegetable often appears under the name of Swiss chard, leaf beets, or sea kale. In Porto Rico it is often sold under the name of spinach, for which it seems to be a fair substitute. It grows very readily here when planted on good beet soil and treated like beets. In gathering the outer leaves, stalks may be cut close to the ground, leaving the heart or inner leaves, which will continue growing and form new plants. The leaf stalk or midrib is the edible part, but the leaf blade can also be used and should be left intact when marketing the product. After rinsing in cold water the stalks should be tied in bunches, in which it makes a very attractive appearance and usually sells well.

CHAYOTE.

The chayote (*Sechium edule*)[a] is cultivated in all parts of the island, but nowhere extensively enough to supply an export market. The chayote is usually grown in the shade of bananas, trees, or shrubs, which are believed to act as a protection for the plants and also a cheap support for the vine. This method seems to be naturally adapted to growing chayotes for home use only; the popular belief that it is the only method or best method is incorrect.

The soil should be a rich, well-drained loam capable of holding an abundance of moisture or capable of irrigation. If the soil is not naturally rich, the plants will respond favorably to stable manure.

PLANTING.

The seed which protrudes from the stem end of the fruit often germinates while the fruit is attached to the vine, or it will germinate in storage. The whole fruit should be planted, being placed on the side and partly covered with soil, a small amount of loose litter being placed on the top to conserve the moisture. The distance apart of the plants will depend entirely on the construction of the trellises. One of the best trellises for chayotes is made as follows: Set 8-foot posts 2 feet in the ground 10 feet apart in straight rows 10 feet apart. Then nail crosspieces (as strong as a board 1 by 6) to the top of the posts in line one way and stretch wires 2 feet apart at right angles

[a] This climbing, cucurbitaceous tropical plant is a perennial which bears numerous greenish or white pear-shaped fruits, weighing from ½ to 3 pounds each. These are used in much the same way as the summer squash. (Pl. III, fig. 2.)

over the top of this support. One plant may then be planted at each post, which will serve as a support for the vines until reaching the wires. No training is necessary, as the vines will soon cover the trellis, and when bearing the fruits will be hanging down and can be picked from below.

HARVESTING AND MARKETING.

There has lately been some interest manifested in the chayote as a winter vegetable for the northern market. It is very little known yet, but it was very favorably commented upon at some of the best hotels in New York and Philadelphia in some recent trial shipments from this station and it would no doubt be possible to create a profitable market. The fruit should be gathered before fully matured, because of the tendency to germinate. It is like the cucumber, edible at any stage of growth, and may be picked when large enough. The chayote is a good shipper and may be shipped in bulk in vegetable crates. If wrapped and well packed, cold storage will not be necessary.

VARIETIES.

There are several varieties and it is possible the northern market will prefer the white ones on account of the color; the green ones are as palatable, however. In fact, one green pear-shaped variety found in Mayaguez is superior to any of the white varieties coming under the writer's notice. Two varieties, one white and one green, were received from Mexico through the Bureau of Plant Industry of the U. S. Department of Agriculture. These were of large size, but objectionable on account of the very stiff spines. They were about equal in vigor and prolificness to the average varieties here and were subject to the same diseases.

DISEASES.

The chayote plant is subject to a fungus disease (*Cercospora* sp.) which attacks the leaves. It sometimes appears shortly after planting and sometimes not before the vines have had a crop of fruit, but no matter when, it causes the death of the vines in a comparatively short time. When dead the vines should be cut off close to the ground, pulled away from the trellis and burned so as not to infect the new vines which come up from the roots almost immediately. The same disease, apparently, destroyed the vines of chayotes which the writer tried to grow in Florida. There Bordeaux mixture was tried without effect. Nothing has been tried here yet, but it is certain that a remedy must be found before the chayote can be grown on a commercial scale. This fungus may possibly not cause as much damage in other parts of the island, but it was found by the writer at Bayamon, Ponce, and La Carmelita.

COLLARDS.

This very delicious green is not grown extensively in Porto Rico, although it is known here under the name of headless cabbage (Repollo sin Cabeza). There is no reason why it should not be grown in every home garden and even market gardens. It requires exactly the same treatment as cabbage, but it can be grown where cabbage is unprofitable. It is attacked by cabbage worms, but it grows very vigorously and there will always be enough young leaves which can be picked before being attacked by this pest; in fact, the leaves should always be picked while young, being careful not to injure the heart. The plant is a perennial, and when the lower leaves are kept picked it soon assumes the shape of a palm tree with its naked stem and cluster of leaves at the top.

CRESS.

Both upland and water cress can be grown to perfection in Porto Rico. Of the upland cress, the curled or pepper grass is preferable. It should be sown in drills 18 inches apart and kept free from weeds. If sown every two to three weeks it can be had fresh all the year.

Water cress should be sown in moist soil near a spring or any other suitable place where it is not liable to be washed out by heavy rains. If kept free from weeds until well established it will grow perennially without much care.

CUCUMBER.

This vegetable is sold in the market places all over the island. The ones found in the markets were always comparatively short, very thick, and fully ripe. Judging from the results obtained at the station, and especially from reports received from other parts of the island, it would seem that Porto Rican conditions are especially adapted to the growing of cucumbers for the northern market. The most suitable soil is a sandy loam, although a heavier loam will do very well. A light sand or a heavy clay should not be chosen unless no other is available. Any soil, and especially the last two, may be greatly improved by an application of stable manure, which should be applied in the hill some time before planting.

PREPARING THE FIELD.

The soil, which should be in good physical condition and free from weeds, should be laid off in checks 6 by 6 feet, and the fertilizer should be applied in the checks. Stable manure is an excellent fertilizer for this crop, and should be used wherever procurable. A hole should be dug about 2 feet wide and 15 inches deep in each check. Two or three forkfuls of stable manure and a good handful of sulphate of potash should be well mixed with the soil taken out, and this should then be used to refill the hole. This will more than fill the hole, but the extra

material should be heaped on the top, leaving a small mound flattened on the top. If commercial fertilizer is used, a mixture containing 5 per cent nitrogen, 8 per cent potash, and 7 per cent phosphoric acid may be used at the rate of about 1,500 pounds per acre. This should be applied in a space about 4 feet in diameter around each check and worked into the soil by hoeing back and forth three or four times, hoeing it toward the hill the last time, so as to leave a small mound. After fertilizing, the field should be left two or three weeks before planting.

PLANTING AND CULTIVATION.

When ready to plant, 6 to 12 seeds should be scattered on the top of each mound and covered with soil to a depth of 1 inch. Germination takes place in a few days, and the plants grow very rapidly; if not, the application of a teaspoonful of nitrate of soda or a little liquid manure will force them on. When well out with the second leaves, the plants should be thinned out to not more than two or three in a hill.

Cultivation consists of stirring the soil and keeping the weeds down, which for the first few weeks can be done by running a cultivator in all directions through the field; but the vines usually grow so rapidly that cultivation will have to be discontinued at an early date. Pinching the vines for the sake of making them branch is not necessary in this climate, and pinching for the sake of keeping them down to a uniform size is simply useless because of the vigorous growth.

VARIETIES.

Cucumbers are grown for salad and for pickles, and the varieties must be selected according to these requirements. (Pl. IV, fig. 1.) For a salad cucumber the market requires a long, slim, light-colored fruit, but for pickles the cucumbers should preferably be short, green, and smooth. For salad the White Spine is a good all-round variety, and probably most of the varieties of that type will be found to be well adapted for culture here. The Fordhook Fancy gave far the best result of any tried at this station. For trellising the Japanese Climbing and Telegraph will give good results, and that method is very profitable, although it is not very extensively practiced in outdoor culture. For pickling, the following varieties are well adapted: Long Green, Green Prolific, Green Cluster, and Nichol Medium Green.

HARVESTING AND MARKETING.

For salad a cucumber may be picked at any time, but it should preferably be left to grow as large as possible without getting too nearly ripe. A cucumber in which the seeds are mature is unsalable, and if fruits are left to ripen the vines cease bearing in a short time. The vines should be gone over every other day and all the marketable

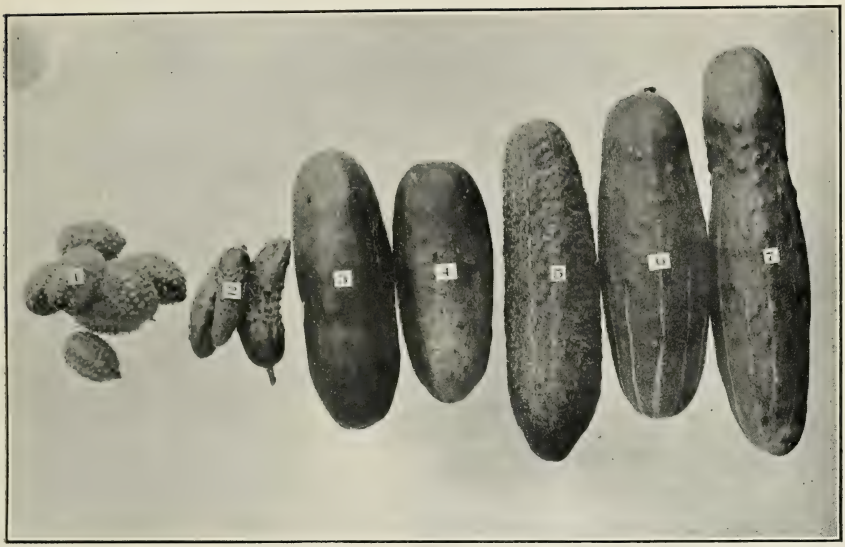

FIG. 1.—GHERKINS AND CUCUMBERS, SHOWING VARIETIES.

1, Gherkin; 2, Pickle cucumbers; 3, Green Prolific Pickling; 4, Improved Long Green; 5, Princess; 6, Improved White Spine; 7, Fordhook Fancy.

FIG. 2.—IMPROVED AND NATIVE EGGPLANTS.

fruits picked. In picking, the stem should be cut and not pulled, thus avoiding injury to the vines. When packing, the fruits should be carefully culled, leaving out all the small, deformed, wormy, overripe, and bruised specimens. For shipping, the ordinary vegetable crate may be used, packing the fruit in even layers and nailing the cover on under pressure. Shipping in refrigerator compartments is not strictly necessary, but it will be good policy to do so in order to obtain fancy prices.

For pickling, the vines should be gone over every day, the cucumbers being picked when very small. The growing of pickle cucumbers will not be profitable unless enough can be grown to supply a factory. The cucumbers may be pickled in a salt brine containing 7 to 10 pounds of salt per bushel of fruit, and should be kept that way until wanted, when they may be soaked in fresh water and then pickled in vinegar. It is well to remember, however, that in this climate the cucumbers become soft and unfit for use in a few months when kept in brine.

DISEASES AND INSECTS.

A disease called leaf glaze is likely to appear on young plants when checked in early growth. It is characterized by small curled-up leaves and deformed fruits, also by a glazed appearance of the underside of the leaf. It can usually be prevented by keeping the plants in a growing condition.

Downy mildew (*Plasmopara cubensis*) is distinguished by a yellowing and final drying up of the older leaves. It never attacks a leaf which is not fully developed; therefore when the plants are very vigorous they will often continue bearing for a long time, although the basal ends of the vines may be entirely denuded. Spraying with Bordeaux mixture every ten days to two weeks will keep this disease in check, but twice the usual amount of water must be used, as cucumber leaves are very tender.

Striped cucumber beetle (*Diabrotica vittata*) does much damage here by eating the young leaves, but it can be checked to some extent by spraying with arsenate of lead. Bordeaux mixture when used for mildew acts as a repellant, and air-slaked lime sprinkled with turpentine at the rate of 1 quart to the bushel gives some relief. When, however, this insect is present in large numbers the remedies specified above are of little avail.[a]

Pickle worm (*Diaphania nitidalis*). The larva of this insect feeds on all cucurbits by eating into the fruit. It is very destructive, and can not be reached by poisons after it has penetrated the fruit.

[a] Further information is furnished in U. S. Dept. Agr., Bureau of Entomology Circ. 31, which will be sent on application to the Secretary of Agriculture.

DANDELION.

This is commonly found in the markets and seems to be much appreciated, although it is always small, green, and bitter. It grows very readily, and a superior product can be grown with very little care. The wild forms should not be grown, as they are much inferior to the cultivated varieties, like Improved Thick Leaf and French Garden. Seeds should be sown in rows 2 feet apart and the plants thinned to a distance of 1 foot. When green the leaves are more or less bitter, and the quality can be greatly improved by blanching with boards or palm leaves.

EGGPLANT.

The long, light-colored sorts cultivated here are small and of inferior quality, which may be partly attributed to the cultivation, or rather, lack of cultivation. (Pl. IV, fig. 2.) The eggplant can be grown successfully here on all the different classes of soil, from light sand to heavy clay, but a light loam is preferable. For growing on a commercial scale it will be necessary to apply commercial fertilizers. Professor Rolfs, in Cyclopedia of American Horticulture, recommends an application of 500 to 3,000 pounds per acre of a fertilizer containing 4 per cent nitrogen, 9 per cent potash, and 5 per cent phosphoric acid. For most Porto Rican soils 1,500 pounds per acre of this fertilizer would probably be sufficient. The land should be laid off in checks 4 by 4 feet and the fertilizer applied in a space of 18 inches in diameter around each check. The fertilizer should be thoroughly worked into the soil, after which it should be left for about two weeks before planting.

PLANTING.

Seeds may be sown in ordinary seed beds or seed boxes, but the method of sowing in bamboo sections gave such favorable results in experiments at this station that it can be strongly recommended for general use wherever the bamboos can be had cheap, and especially where the weather conditions are unfavorable for transplanting or where the changa or cutworms are numerous. When sown in seed beds, the plants should be thinned out as soon as well out of the ground in order to make them stocky.

TRANSPLANTING AND CULTIVATION.

The plants may be set in the field any time when large enough and under favorable conditions. No precautions are necessary beyond those given under the general subject of transplanting.

The amount and kind of cultivation necessary will depend largely on the class of soil. Loose, friable, and rather dry soil should be cultivated often and thoroughly in order to preserve the moisture. A heavy clay soil may be moist enough, but it will be greatly benefited by cultivation which admits air to the deeper strata.

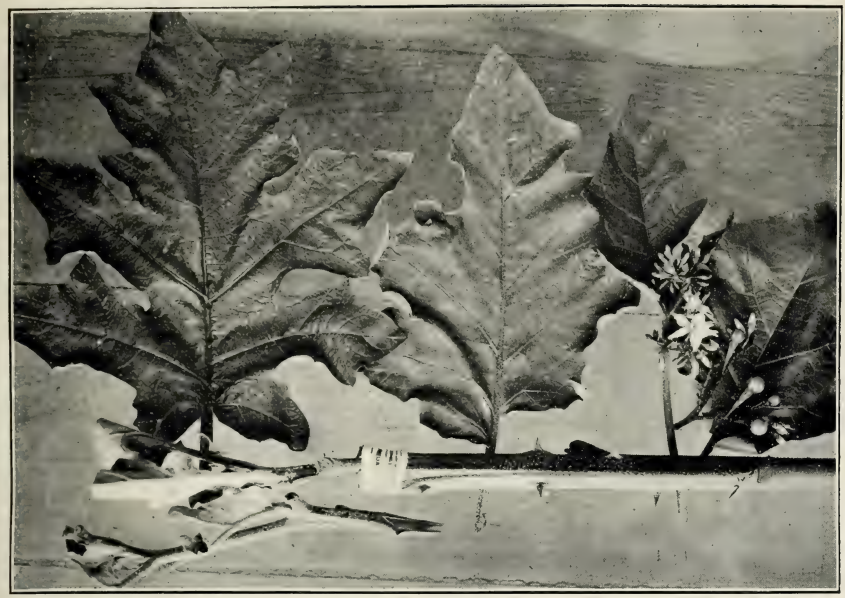

FIG. 1.—LEAVES OF EGGPLANT, SOLANUM MAMMOSUM, AND S. TORVUM, AND METHOD OF GRAFTING EGGPLANT ON WILD SPECIES OF SOLANUM.

FIG. 2.—ENDIVE AND LETTUCE, ENDIVE IN CENTER.

HARVESTING AND MARKETING.

The eggplant is edible when very young, but for marketing it should be left until fully developed. It should not be left to ripen, however, for when the seeds are ripe or nearly so the fruit is worthless. The fruits, no matter what color, are always more or less lustrous. This luster is lost and a more dull hue assumed when the fruit is ripening. This is the right stage for gathering for the home market, but for five or six days' transit the fruit should be cut before reaching that stage, and nothing but experience will tell the exact time. For marketing, the fruits should be wrapped in paper and may be packed in crates of the same capacity as a 200-pound flour barrel. They stand shipment well and refrigeration will not be necessary.

On account of the known resistance to disease of a number of wild species of Solanum, an experiment was undertaken in budding and grafting the cultivated eggplant on stocks of common wild species, especially upon those of *Solanum mammosum* and *S. torvum*, both of which are weeds in Porto Rico. (Pl. V., fig. 1.) Most of the common methods of budding and grafting were tried with stock and scion of different ages. Budding was not found to be successful, for while it was not difficult to form a union if the budding was done while the stock was young, in every case it was found difficult to force the bud and make it grow. In grafting, the common cleft graft is used by the natives, and that was found to be not only the easiest but also the most successful. The graft should be inserted while the stock is young or before the stem becomes woody. The union is perfect and the graft grows rapidly. For use as stocks there seems to be little choice between the two species named, and it is possible that other solanaceous plants may be found adapted to this purpose. In all the experiments *S. torvum* was found to answer the purpose very well. It grows abundantly everywhere, and the seeds can be obtained at any time in the year. The seeds of this species are slow to germinate and should be treated like the seeds of the eggplant. In fields which are known to be infected with certain diseases like the bacterial disease and diseases due to soil fungi the method of grafting may be used to good advantage.

DISEASES AND INSECTS.

A fungus disease (*Sclerotium* sp.), which attacks the plant immediately below the ground, is likely to occur where stable manure, compost, or any other coarse organic material is present in the soil. There is practically no cure for it, but it may be prevented by spraying the soil around the plants with ammoniacal carbonate of copper.

Bacterial blight (*Bacillus solanacearum*), a very serious disease of eggplants and tomatoes in the Southern States, is also prevalent here. It causes the plants to wilt and die in a very short time. If a

crop of tomatoes or eggplants has previously been grown and has shown signs of the disease, it will not be safe to plant in that field again. If it occurs on a few plants only, there is a chance that it has been introduced from some other field and insects may be suspected of being the carrying agent. It will therefore be well to be on the lookout, to destroy all infected plants, and also to spray for the kinds of insects present. Fungicides have so far been of no value.

Anthracnose (*Glœosporium melongenæ*) is a fungus disease appearing on the fruit as dark-colored spots with pink edges. It is especially prevalent on the fruits which are touching the ground or much shaded by the overhanging leaves. Frequent applications of Bordeaux mixture will keep the disease in check.

The eggplant aphis, a small light gray, mealy looking insect, appears on the underside of the leaves. It multiplies very rapidly and might be checked by spraying as soon as possible with a combination of tobacco decoction and kerosene emulsion, using about 10 parts of the former to 1 part of the latter.

ENDIVE.

This green or salad plant is grown on the island but is mostly of inferior quality. (Pl. V, fig. 2.) It will grow on any common garden soil and should be treated like dandelion. Blanching may be done by tying the outer leaves so as to cover the heart. This, however, is liable to induce rot when the weather is damp, and tiles or boards used as in celery blanching, are much preferable. The White Curled is especially recommended for salad because it blanches most readily. Moss Curled and Savoy Leaved are also good.

HORSE-RADISH.

As this has always been considered strictly a cold-weather plant, it would seem useless to try to grow it in Porto Rico, but, as it gave very favorable results at this station, it can no doubt be produced for local consumption. It is practically unknown in Porto Rico, but most people acquire a taste for it, and foreigners, who are used to it in their native country, will find it very gratifying that they can grow it here. In the North it thrives in any soil from a light sand to a heavy clay, but prefers a medium heavy loam. Here it grows luxuriantly in heavy clay but may not do so well in sand. It is planted from cuttings of the lateral roots, which should be from 4 to 6 inches long and planted at a distance of 12 to 15 inches in rows 24 to 30 inches apart. Root cuttings can be obtained either in spring or fall from any seed firm, and these should be planted when received. The roots can be dug when large enough for use or can be left in the ground until wanted.

KALE.

This is one of the most delicious of all the greens and ought to be in every home garden. It grows readily under the same treatment as cabbage, which may be referred to for culture and diseases and insects (pp. 26, 27). Scotch Curled, Dwarf German Curled, and Siberian are good varieties.

KOHL-RABI.

This vegetable is practically unknown in Porto Rico, but in Europe, and to a limited extent in the United States, it is very much relished. It has the flavor of cabbage and turnip combined and as it grows fairly well in Porto Rico, it will be found a valuable addition to the list of vegetables which are used like cabbage and turnips. (Pl. IX, fig. 2.) For culture and diseases and insects, see "Cabbage" (pp. 26, 27).

LEEK.

This is not commonly grown in Porto Rico, but it is very much relished as a substitute for onions. It will grow in any soil which will grow onions, and it seems to be better adapted to Porto Rican conditions and able to stand more neglect than the best adapted varieties of onions. For methods of culture, see "Onion" (p. 43). When the plants are well grown the stalks should be blanched with boards, tiles, or earth. This is not a difficult process as they blanch readily. Two varieties, London Flag and Musselberg, have been grown successfully here.

LETTUCE.

The lettuce commonly grown in Porto Rico is but a poor substitute for the real article. It can be grown to perfection here (Pl. V, fig. 2), but the following requirements must be fulfilled:

(1) Plant seed of good varieties only, which were well grown and can be depended upon to come true to name. Such can be obtained from any reliable seed firm, but home-grown seed is usually inferior, especially in the Tropics.

(2) A seed bed must be available which contains rich, mellow soil and which can be protected from ants.

(3) The soil in the lettuce field must contain an abundance of available fertilizer, because the plants must grow and attain full size in the shortest possible time.

These requirements apply to commercial lettuce growing only, because a fair grade for home use can be grown in any garden with no more than ordinary care.

The best soil for lettuce is a rich, well-drained clay loam. For fertilizer, a good application of well-rotted stable manure may be used to good advantage whenever procurable. If that is used, it should be applied together with 150 pounds of muriate of potash and 250 pounds of acid phosphate to the acre. This should be worked into the soil and

left four to six weeks before planting, in order that the plant food may become available.

SOWING THE SEED.

Lettuce should be sown broadcast or in drills 6 inches apart in seed beds or seed boxes. Germination takes place in two to five days and the plants which grow rapidly will begin to crowd each other in less than two weeks, at which time they should be pricked out to a distance of 2 inches apart. When they fill that space the plants will be ready for the field.

TRANSPLANTING.

The plants may often be removed from the seed bed with some soil adhering to the roots. If this can be accomplished they can be transplanted without perceptibly checking the growth. In large fields it is usual for a boy to carry the moistened plants in a covered basket and drop one in every space in the row, and a man who follows close behind will set the plants with a dibble. A boy again follows him with a watering can and applies water to every plant. The plants should be set at a distance of 10 to 12 inches in rows 20 to 24 inches apart, and in three or four days, when the roots are starting to grow, a small teaspoonful of nitrate of soda should be applied to each plant. This will start them off well, and if the ground is kept moist and well cultivated the lettuce will be ready for market in three or four weeks.

VARIETIES.

Lettuce may be classed according to habit of growth. Some varieties grow in more or less loose bunches and others form distinct heads like cabbage; then again some varieties are somewhat intermediate between the two.

Of the bunching varieties, the Early Curled Simpson, Black-Seeded Simpson, and Iceberg gave best results in the station trials. Giant Crystal Head was also promising. Oak Leaf was of longer standing than any other variety and can be highly recommended for home use.

Of heading varieties, Black-Seeded Tennisball, Large Summer Cabbage, and Unrivaled seem most promising. However, Large Boston Market, California Cream Butter, Hanson, Salamander, Golden Queen, and Deacon may be found as well adapted under other conditions.

HARVESTING AND MARKETING.

Lettuce can be used at almost any stage, but for marketing it should be fully developed. It is at its best at a certain period, which is different for the different varieties and must be determined by the grower in every case. That period is of but a few days' duration, and, if the grower is in doubt, it is better to cut it too early

FIG. 1.—LLEREN.

FIG. 2.—OKRA, PLANT AND FRUIT.

FIG. 1.—MUSKMELONS, SHOWING VARIETIES.

1, Long Yellow; 2, Champion Market; 3, Hackensack; 4, Round Netted Gem; 5, Mango; 6, Rockyford; 7, White Japan.

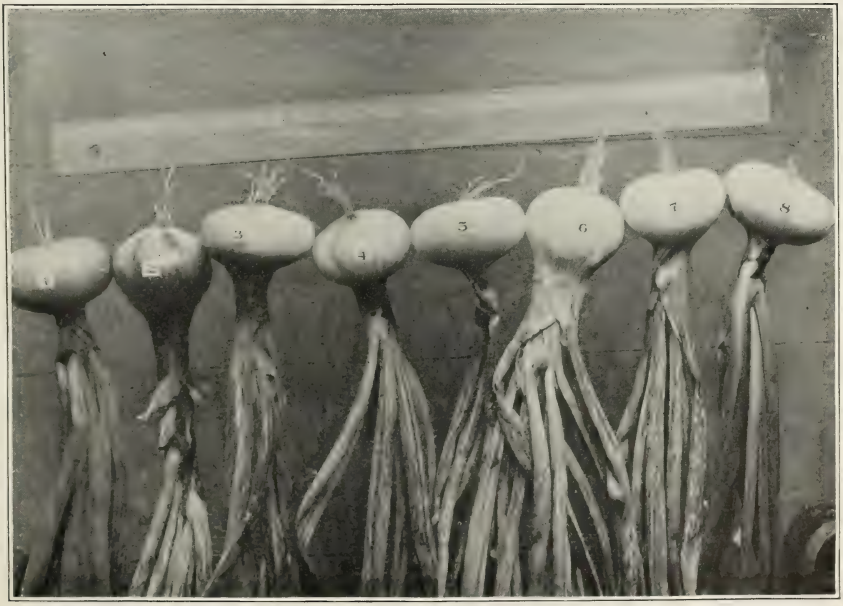

FIG. 2.—ONIONS, SHOWING VARIETIES.

1, Red Rocca; 2, Red Globe; 3, Red Bassano; 4, Yellow Strasburger; 5, White Barletta; 6, White Globe; 7, White Tripoli; 8, White Victoria.

than too late. Lettuce for shipment should be gathered in dry weather only; the stem should be cut off close, and the heads packed in crates or lettuce baskets. Packing should be done carefully, so as not to crush the leaves and at the same time firmly enough to prevent shaking. For shipping to the States, refrigerator compartments will be necessary.

LLEREN (*Calathea allouya*).

This vegetable, although cultivated in Porto Rico for a long time, is not extensively known. (Pl. VI, fig. 1.) The plant at a cursory glance resembles a canna. The edible tubers, which are formed in great profusion, can be eaten boiled like potatoes; but, unlike potatoes, they do not become soft, but appear hard and crisp after prolonged boiling. Lleren somewhat resembles boiled sweet corn in taste, and most people pronounce it delicious without needing to acquire a taste for it.

The best soil for lleren is a rich, moist, well-drained loam, which is usually benefited by an application of wood ashes or sulphate of potash; an excess of nitrogen causes the production of large tops and few tubers. The stools or roots immediately adhering to stalks are the parts used for propagating; the tubers will not germinate.

Lleren should be planted at intervals of 2 feet in rows 4 feet apart, and cultivated like any other vegetable. It requires ten to fifteen months to mature tubers, which are $\frac{3}{4}$ to 1 inch in diameter, and may be harvested at any time when large enough, but can be left in the ground for a long time without spoiling. It is a good shipper and if introduced into the northern market it would soon create a demand.

MUSKMELON.

This is grown to some extent in Porto Rico, especially a large variety resembling Large Yellow Cantaloupe, which is of very good quality and seems to be well adapted to the conditions. (Pl. VII, fig. 1.)

The muskmelon thrives well on any soil from sandy loam to heavy clay, but a lighter clay loam which is well drained will no doubt be found to give best results here. The cultural requirements are the same as for cucumbers. For diseases and insects, consult "Cucumber" (p. 35).

VARIETIES.

Of the shipping varieties, Rockyford and Hackensack gave best results in the station experiments. Both are good standard varieties in the States and may become so here as well. Of other varieties, Bay View, White Japan, Paul Rose, Champion Market, and Nutmeg were promising; and, for home use or local demand, the large Yellow

Cantaloupe and the native-grown strain of the same can be highly recommended.

HARVESTING AND MARKETING.

The muskmelon is a good shipper, and ought to become a very profitable crop for the northern winter market. For shipping, the fruit should be gathered before fully ripe and when thoroughly dry; it should be packed in ventilated crates and preferably shipped in refrigerator compartments.

MUSTARD.

This is not grown as extensively here as it ought to be. It grows readily in any garden soil and requires but little care. Some varieties are grown for the leaves, which are used for greens, and other varieties are grown for the seed, which when ground forms the well-known condiment. For greens the Southern Curled and Chinese Broad Leaved are suitable varieties. Seed should be sown in drills 2 feet apart, and the plants should be thinned out to 10 inches in the row. For seed mustard the black is commonly used. Seeds may be sown in drills 2 feet apart and thinned out to 1 foot in the row, or broadcast, at the rate of 8 quarts per acre. In harvesting the seed, the plants may be cut with a scythe and left to dry, after which it may be thrashed out with a flail and cleaned with hand sieves.

OKRA.

Some good varieties of okra are grown here, but the product usually sold in the market is of inferior quality on account of improper culture. The plants grow very readily, and consequently do not receive much care, but cultivation and fertilization are strictly necessary in order to produce first-class pods. (Pl. VI, fig. 2.)

PLANTING.

Okra thrives well on most well-drained soils, which, if not rich, should be fertilized with stable manure or a complete commercial fertilizer. The seeds should be sown by dropping a few in hills at a distance of 2 feet in rows 4 feet apart. When well established, the plants should be thinned out, leaving only one in a place. Cultivation may be done with any suitable horse implement and should be thorough enough to keep the plants in good growing condition.

VARIETIES.

There are tall and dwarf varieties of okra, the latter being earlier than the former. This is of minor importance here, where it may be planted any time of the year, and will continue as a perennial as long as cultivated. The white-podded varieties are preferred by certain markets, but regardless of varieties none but pure strains should be planted.

HARVESTING AND MARKETING.

The okra pod is at its best when well developed and before it becomes tough. It is just right when the tip can be snapped off with the fingers, but too old when it bends or tears. When at the right stage, the pod stem should be cut at one-half inch to 1 inch long and the pods packed in ordinary vegetable crates. In shipment refrigerator compartments will not be necessary for four or five days' transit. There is often a good demand for okra in the northern winter market, and Porto Rico is fully able to supply all the northern cities of the United States and Canada.

ONION.

Most of the onions consumed in Porto Rico are imported. Just why this is so the writer has been unable to ascertain. (Pl. VII, fig. 2.) Onions have been grown even on a commercial scale in several places in Porto Rico, and fair success has been reported; but the culture seems to have been of one year's duration only. Onions will grow on nearly all kinds of well-drained soil, but for extensive culture a rich loam should be selected if procurable. A light sandy loam is also suitable, provided it is able to retain an abundance of moisture. The land should be mellow and free from lumps and trash. It should also be perfectly clean from weeds and weed seeds, a condition which is best secured by planting a crop of legumes, like cowpeas, and then keeping the ground clear of weeds until the crop fully covers the ground. If the legumes are plowed down four to six weeks before planting and the ground is thoroughly prepared with a disk harrow, drag harrow, and smoothing board, the field should be in good condition for onion planting. If the soil is well fertilized and no diseases occur which are able to continue from one year to another, the same field may be planted to onions for many years in succession and yield as well the last year as the first or even better. Of course, in the drier sections of Porto Rico, where irrigation is available, it would be possible to grow two crops a year. This would be exceptional, however, and where one crop a year only is grown the land should be planted to legumes immediately after harvesting the onions.

For fertilizer, a good application of stable manure is excellent and if legumes are planted the manure should be applied before that crop. After plowing the legumes down a commercial fertilizer containing 4 per cent nitrogen, 10 per cent potash, and 8 per cent phosphoric acid should be applied at the rate of 1,000 pounds per acre. If no stable manure is available and no legumes are plowed under, the fertilizer should contain proportionally more nitrogen and should be applied at the rate of 2,000 to 3,000 pounds per acre. Besides that 300 to 400 pounds of nitrate of soda should be kept on hand for application throughout the growing season. This may seem excessive, but as a

matter of fact the figures have been made as low as would be safe for the growing of a profitable crop, and it will often be advantageous to apply a great deal more, because the expense of preparing the land, growing and transplanting the seedlings, and afterwards keeping the field cultivated and clean is a large item in onion growing. It will readily be seen that if a soil will produce 1 ton of onions per acre with an application of 1,000 to 1,500 pounds commercial fertilizer, it would pay to apply 2,500 to 3,000 pounds in order to double the yield. A conservative estimate of yield on soil physically suited for onion growing would be 10 tons per acre on medium rich soil and 15 tons on soil well fertilized.

SOWING THE SEED.

Onion seeds lose vitality in a short time and fresh seeds should always be obtained. The crop of Bermuda seed comes into the market in the fall, not usually before November. If kept over until next fall it can not be depended upon to germinate, and it will usually not pay to plant it. The seeds may be sown in the field or in a seed bed. The method to be adopted will depend on local conditions. Wherever the moisture can be regulated—that is, where the rains are not so heavy as to interfere with the germinating seeds and where the moisture is sufficient or irrigation available—it will often be cheapest to sow directly in the field, but otherwise transplanting will be the better method. If a seed bed is used, it should be prepared by thoroughly working and fertilizing at least four weeks before planting. Seeds may be sown in rows 3 inches apart and the seed bed should be kept constantly moist. The seedlings will be of the size of a thin lead pencil in about six weeks, at which time they will be ready for transplanting.

TRANSPLANTING AND CULTIVATION.

The plants may be set in the field at a distance of 5 inches in rows 12 to 15 inches apart. The rows should of course be straight for the sake of cultivation, which can best be done by hand cultivators. After the plants have started to grow a small amount of nitrate of soda, about 100 to 150 pounds per acre, should be applied broadcast, and this may be profitably repeated twice with an interval of four to six weeks.

If the seeds are sown directly in the field the rows may be laid off at the same distance as by the other method and the seeds drilled in. After the plants are well established they should be thinned out to a distance of not less than 5 inches apart and cultivation should be the same as with the former method.

Onions may also be grown from sets, which are diminutive bulbs that have been grown from seed, but arrested in growth by close crowding in the field. Sets are sold by measure. It requires 6 to 10

bushels for planting an acre. Directions for planting, cultivation, and other treatment are the same as with onions grown from seed.

VARIETIES.

In buying onion seed it is very important to obtain fresh seed of a pure strain true to name. The Bermudas, both white and red, can be recommended for commercial planting. For home use and market garden the White Barletta, White Queen, White Victoria, Tripoli, and White Garganus may be planted; and, of the red varieties, Giant Rocca, Red Garganus, and Bassano.

Some of these Italian varieties may prove to be as satisfactory as the Bermudas, though extensive planting can not be recommended as yet.

HARVESTING AND MARKETING.

In this climate the onion tops do not die down uniformly, but whenever a small percentage shows signs of wilting the whole crop may be hastened to maturity by bending the tops over with some kind of roller. The bulbs should not be left in the ground too long, especially in rainy weather, as they are liable to start a second growth.

Onions are usually harvested by pulling the bulbs and throwing them in windrows where they are left for a few hours to dry, after which they are taken to a curing shed and spread out in thin layers to dry. When they are dry, the tops can be twisted off and the bulbs packed in bushel crates for shipment. If kept for the local trade, they should be stored in a dry airy place, and examined frequently, because one decayed bulb will cause the surrounding bulbs to decay also.

DISEASES AND INSECTS.

Smut (*Urocystis cepulæ*), a disease appearing as black powdery spots on the leaves, is often carried by the seed and may be prevented by soaking the seed in a mixture of 1 ounce of formalin and 2 gallons water.

Downy mildew (*Peronospora schleideniana*) appears as a gray felted coating on the onion tops at the time the bulbs are formed, and may be checked by spraying with Bordeaux mixture, but as that does not adhere well to the leaves about 3 gallons of resin compound should be added.

Rotting appears on the bulbs both before and after harvesting, and may be caused either by fungi or bacteria. Thorough drainage and an application of air-slaked lime will act as a preventive. To prevent rotting in storage the onions should be thoroughly dried and kept in a dry place.

Thrips.—A small yellow thrips attacks the leaves and does most damage to the young seedlings. It may be treated with kerosene emulsion and if checked in time it will not usually do much damage.

PARSLEY.

A plain-leaved variety of this is commonly grown in Porto Rico, but the curled varieties also succeed well. The demand for parsley is very limited, and it should of course not be planted extensively, but a few plants ought to be in every garden. It grows well in any rich garden soil and the seeds may be sown any time in rows 1 foot apart, and the plants thinned out to 4 to 6 inches in the row. The leaves may be used both for garnishing and for flavoring and the roots are also edible, especially of the large-rooted varieties.

PARSNIP.

This vegetable is not often grown in Porto Rico, and it is not probable that it will ever be grown extensively. It can be produced, however, and is a welcome addition to the list of vegetables in the family vegetable garden. It requires practically the same soil conditions as turnips and carrots, and may be planted and treated like carrots, but it requires a much longer growing season. The varieties Early Short Round and Hollow Crown are the best adapted to Porto Rican conditions.

PEAS.

The common garden pea (petit pois, in French, or petipuá, as it is called here) is not commonly grown in Porto Rico. The pigeon pea or gandula (*Cajanus cajan*) is used as a substitute, but as that grows almost wild it will be unnecessary to give cultural directions.

SOIL AND FERTILIZER.

Peas will grow on soil ranging from light sand to heavy clay, but a good, well-drained loam is preferable. The light sand is usually dry and requires a great deal of fertilizer to give good results; the heavy clay is not satisfactory where the rainfall is heavy. In most cases a small application of stable manure will give much better results than would be warranted by the actual fertilizer content, and it will pay to apply it wherever procurable. It should not be forgotten, however, that the pea is a legume and will be able to gather most of the nitrogen from the air wherever the soil conditions are right for the formation of the root nodules, which contain the nitrogen-gathering bacteria, and a commercial fertilizer containing a high percentage of potash and phosphoric acid should be used.

PLANTING AND CULTIVATION.

Peas should be planted 1 inch apart in rows, two of which should be about 8 inches apart. These will grow up and support each other better than when planted in a single row. The next two rows should be planted at a distance of 4 feet from the first two, leaving room to cultivate and gather the crop. The amount of cultivation necessary

will depend on the class of soil. A light sandy soil should have shallow cultivation, but the surface should be stirred often enough to preserve the moisture. A heavy clay should be cultivated deeper and often enough to keep the soil loose and aerate the roots.

In the home garden and even in the market garden where one-half acre is planted to peas, it will pay well to use some kind of support for the vines, and nothing better and cheaper can be found than brush wherever it is procurable. Otherwise stakes driven into the ground on both sides of the double row and cheap twine stretched on both sides will give good support. Supports are not usually used when growing peas on a large scale, although it would often pay well for the large long-keeping varieties.

VARIETIES.

Of the early varieties Gradus and Duke of York are good.

Of the medium early varieties McLean Advancer and Horsford Marketgarden will be found among the best, and of the later varieties Champion of England, Telephone, and Marrowfat can be recommended. The sugar peas, of which both the pods and the peas are eatable, are valued highly in Europe, but are not well known in the United States. They are of superior quality and ought to be planted in every home garden.

HARVESTING AND MARKETING.

Green peas are grown extensively in the trucking districts in the southern United States for supplying the northern winter market. It is a vegetable that will stand shipment, but is far superior in quality if consumed immediately after gathering. The pods should be picked as soon as the peas are well developed, but not left long enough to approach ripening. When at the right stage the pods will be plump and of a bright shiny green color, this will turn to a dull green and later to a yellowish color, when the peas will be unfit for consumption. Not all the pods are ready for picking at the same time; in fact the first picking yields but a small percentage of the whole crop, but picking must be repeated every few days, or as often as enough pods are in marketable condition. The pods should be picked only when dry and should be left an hour or two to wilt before packing. Bushel baskets or crates are used for shipping and the pods are pressed down just enough to prevent shaking. Peas will stand shipment to New York, but more frequent steamers will be necessary, and refrigeration will be advisable.

PEPPERS.

Several good varieties of this vegetable may be found in the markets at almost any time of the year, which shows that it grows readily here; this view was fully confirmed by experiments at this station (Pl. VIII,

fig. 1). A soil which is physically and chemically suited for the growing of tomatoes and eggplants will also produce a good crop of peppers. While young the pepper plant requires about the same care as the eggplant, but after it becomes of bearing age it will stand considerable more neglect. Whenever the soil conditions are right, the plants will grow as perennials and continue to bear several crops, but they should never be planted in low, undrained soil because there they are liable to die without bearing.

The work of sowing the seed, transplanting, and cultivating is practically the same as for eggplant. Peppers are usually planted closer together; but here, where the field can be left to produce several crops, the plants should not be set closer than 4 by 4 feet.

VARIETIES.

Peppers are divided into two classes—the sweet varieties, which are eaten as vegetables, and the pickling varieties, which are used for pickles or dried and powdered, in which form they are much used in Mexico. Of the sweet peppers the varieties Sweet Mountain, Ruby King, and Large Bell are good standard varieties; and of the pickling peppers, the Cayennes and Chilies are largely used. The pickling varieties are all more or less pungent and should never be prepared with bare hands, because the burning sensation is very difficult to eliminate.

HARVESTING AND MARKETING.

The sweet peppers only are grown extensively for long distance market. There is usually a good demand for this vegetable, and owing to the fact that it will not stand much cold the competition from Florida is not very great. Considering that it grows so readily here and is a good shipper, it ought to be a remunerative crop for the northern winter market.

The fruits should be picked when well developed but while still green, and packed in common vegetable crates, firm enough to prevent shaking. In shipping, refrigeration is not necessary if the ventilation is good.

PUMPKINS.

For cultivation of pumpkin, see "Squash" (p. 50). The best varieties for culinary purposes are the Early Sugar and Large Cheese.

RADISH.

Any good garden soil will grow radishes (Pl. VIII, fig. 2), but in order to be of good quality a radish should be ready for the table in eighteen to twenty-six days after the seed is planted. This can be accomplished in rich soil only, and where radishes are grown for market a fertilizer containing 3 per cent nitrogen, 9 per cent potash, and 7 per cent available phosphoric acid should be applied at the rate of one-half ton per acre.

FIG. 1.—PEPPERS, SHOWING TYPES.

1, Small Red Chili; 2, Long Red Cayenne; 3, Large variety of Chili; 4, The Bell or Bullnose type.

FIG. 2.—RADISHES, SHOWING BOTH WHITE AND RED, ROUND AND LONG VARIETIES.

SEEDING AND CULTIVATION.

Radish seeds may be sown by hand or with a seed drill in rows 15 inches apart, and if care is used not to drop more than twelve seeds to the foot no thinning will be necessary. A quick growth is very necessary in radish culture. In cultivating it will readily be understood that the soil must be kept clean from weeds and cultivated often enough to preserve the moisture.

VARIETIES.

Of the round varieties Scarlet White-Tipped and Scarlet Globe are suitable for general culture; of the olive-shaped varieties French Breakfast and Red Rocket can be recommended; and of the long varieties Scarlet Short Top and Brightest Scarlet White-Tipped.

HARVESTING AND MARKETING.

Radishes are edible as soon as large enough. While the root is young it is crisp with an agreeable pungent taste, but when left in the ground a few days too long it becomes pithy and bitter. For marketing the radishes are pulled and washed, after which they are bunched 6 to 12 in a bunch by tying around the top with twine. It is of importance that the bunches should be kept moist and cool from the time of leaving the field until reaching the consumer's table, because a wilted radish does not sell well.

RHUBARB.

The writer has no information concerning rhubarb culture in the Tropics. It is probable that it can be grown here; at any rate it is worth a trial. It is questionable, however, if it could be made a profitable industry for supplying the northern winter market because the plants can now be forced readily and a crop produced when wanted.

SALSIFY.

This vegetable, which resembles a long carrot or parsnip, is seldom grown in the South, and it would probably be difficult to produce a crop equal in quality to the northern-grown product. It can be grown for home use, however, and it furnishes a very fair substitute for oysters; in fact, the roots produced at this station were far superior to the Porto Rican oysters.

The soil requirements are the same as for the common root crops, only it should be made as rich as convenient. The seeds should be sown in rows 2 feet apart and the plants should be thinned out to a distance of 3 inches in the row. Cultivation should be thorough and continuous, because the crop requires longer time to mature than other root crops.

SPINACH.

This pot herb should be grown quickly to be of value. It may be sown in seed beds and transplanted or sown directly in the field, but either method has its disadvantages. If it is transplanted, it will be checked in growth and be bitter before fully developed unless the soil is very rich in available nitrogen and of uniform moisture. If sown in the field the seeds germinate poorly unless the conditions are favorable.

The soil for spinach should be a rich moist loam. The plants should be set 1 foot apart in rows 2 feet apart, and after starting growth a sprinkling of nitrate of soda should be applied and worked into the soil. This may be repeated to good advantage in two or three weeks, as quick growth is of the greatest importance. When full grown, the heads should be harvested and marketed like lettuce.

SQUASH.

Varieties of squash may be classed as bush and running varieties. The bush varieties are seldom grown in Porto Rico, although they are well adapted to the purpose and of much better quality when cooked than the large winter varieties. The latter, together with pumpkins, are here known as calabash. Many different forms which would be difficult to classify under known varieties are grown here and may be found in the markets nearly any time of the year. (Pl. IX, fig. 1.) The soil for squash should be like that for melons and cucumbers—well prepared and fertilized in the hill. The bush varieties can be planted 4 by 4 feet, but the running varieties will require a space of 8 by 8 feet.

VARIETIES.

The White Scalloped and Yellow Crookneck are the most desirable bush varieties. Of the running varieties Delicata makes a very good substitute for apple sauce, as it has both the scent and flavor of the apple. It is small but early and quite prolific. Of the large varieties the Hubbard can be strongly recommended, and both the English and Italian vegetable marrows are worth cultivating.

HARVESTING AND MARKETING.

The bush varieties should always be picked before the shell becomes hard. They may be marketed in barrels or preferably barrel crates. They should not be shipped to the United States unless the price warrants it.

The running varieties, especially the large winter sorts, such as Hubbard and Boston Marrow, should not be grown for shipping to the States, because there they can be produced cheaply and kept in storage all winter.

FIG. 1.—SQUASHES, SHOWING VARIETIES.

1, Yellow Crookneck; 2, English Marrow; 3, Orange Marrow; 4, White Scalloped; 5, Golden Scalloped; 6, 7, Delicate.

FIG. 2.—TURNIPS, WITH KOHL-RABI ON LEFT.

DISEASES AND INSECTS.

The downy mildew and striped cucumber beetle are the worst enemies of squash in Porto Rico. For description and remedies, see "Cucumber" (p. 35). The squash vine borer (*Melittia satyriniformis*) is an insect, the moth of which lays its eggs on the vines. The caterpillar bores its way into the stem where its presence can be detected by minute pellets surrounding the entrance and on the ground beneath and by other signs.[a]

TOMATO.

The tomato when it was brought into cultivation three hundred years ago was probably not much inferior to the one commonly grown in Porto Rico at the present date. The fruit is flat, deeply creased, of a light color, and more or less acrid to the taste. This acrid principle is especially perceptible in the smaller deeply creased fruit. If the plants are well cultivated and fertilized for some generations the fruits become gradually rounder, smoother, and of a better flavor. This unimproved tomato is hardier and more disease resistant than the improved varieties. It is subject to the prevailing tomato diseases, however, and there seems to be no good reason why the improved varieties should not be cultivated instead.

SOIL.

The tomato will grow in any soil found in Porto Rico, provided it is well drained and able to retain moisture. The plants do not need a great amount of moisture, but if the soil becomes dry enough to check the growth or if the air is very dry and heavy winds sweep the field the results are liable to be disastrous. This is not because of the physical setback, which could readily be overcome, but because, when a plant is checked in growth and its vitality lowered, diseases very often gain entrance as they would not if the plant remained vigorous. Tomatoes should not be planted on land which is not well drained, because a water-soaked soil is detrimental to this crop. In Florida, where the tomato is the chief trucking crop, the grower selects new land whenever such is available. This is cleared of all roots and stumps and plowed, after which the rows are laid off 4 feet apart. A furrow is then opened in the row in which the fertilizer is applied. This is usually (1) a small amount of stable manure, which is beneficial, not so much on account of the actual fertilizer it contains as through the physical and bacteriological influences it exerts; and (2) complete commercial fertilizer at the rate of 500 to 1,000 pounds per acre. These fertilizers are thoroughly mixed with the soil by passing a cultivator

[a] Methods of controlling this pest are given in U. S. Dept. Agr., Bureau of Entomology Circ. 38. Copies will be furnished to applicants.

up and down the row several times. In Porto Rico it would be difficult to obtain uncleared land, but any cultivated land is suitable, provided it has not been planted with tomatoes long enough to be infected with the common tomato diseases. New land is preferred in Florida, because the blight is not present in it, and one or two crops are reasonably sure. This may be of some importance in Porto Rico also, but there are certain problems connected with that which have not been thoroughly worked out yet.

VARIETIES.

There are many varieties of tomatoes quoted in seed catalogues, most of which are fairly good. They may be classed according to the form of the plant as dwarf and running; also according to the size of the fruit or its color. The dwarf varieties are represented by Dwarf Champion, Dwarf Stone, Turner Hybrid, Dwarf Aristocrat, and others. These varieties are of an upright growth and do not attain a very large size. They can be planted 2 feet apart in the row and trained to a single stake. The running varieties include both the large-fruited and small-fruited types, the last of which are represented by those which bear fruits shaped like the cherry, currant, peach, plum, and pear, all of which are duplicated in red and yellow varieties. All of these types are very vigorous, prolific, and not especially subject to diseases. The fruit is of good quality for preserving, but too small for slicing, with the exception of Red Peach, which is very delicious and of rich red color. The large-fruited types are represented by an endless number of named varieties, ranging in color from light purple to dark red, and including some golden yellow; also ranging in forms from flat more or less creased to round, smooth, and even oblong. For canning purposes a large fruit like the Ponderosa is especially desirable, but for slicing a fruit weighing 4 to 6 ounces, round, smooth, solid, and of a dark-red color, is much preferable. From the grower's standpoint it is very important that the plant should be vigorous, prolific, and well adapted to the locality, besides producing fruit with the above qualities. Among the varieties embodying most of these points Burpee Quarter Century is one of the best. Atlantic Prize, Beauty, Early Ruby, Matchless, Perfection, and Stone are good standard varieties. Some of the English forcing varieties, like Carter Duke of York, Dobbin Champion, Hazell Wonderful, Sutton A 1, and Sutton Best of All, gave excellent results when grown at this station. Chalk Early Jewel and Spark Earliana have been much lauded in Florida of late years, but in the experiments at this station they were not vigorous enough to be of much value.

PLANTING.

Wherever the tomato is extensively cultivated the seeds are sown in a seed bed and transplanted. The seed bed should be well fertilized and prepared some time before planting. The seeds should be sown broadcast at the rate of one to the square inch and the bed covered with plant cloth. This should be gradually removed, so as to admit light and prevent the plants from becoming spindling. The seedlings should also be thinned where they are too crowded, because a short, stocky plant with a good root system is much the best for transplanting.

TRANSPLANTING.

The plants are set in the field at a distance of 4 feet apart. If short and stocky, they may be planted with a dibble; but, if somewhat spindling, it is better to remove a portion of the soil with one stroke of a hoe, lay the plant in the hole horizontally, and cover with soil, leaving the top only exposed. When starting to grow, new roots will form along the covered stem, making a large root system for the plant. With this system of planting the weather conditions are immaterial if the soil is moist, because there is not enough of the plant left exposed to cause it to wilt.

The tomato may also be sown directly in the field by dropping a few seeds about a foot apart in the rows previously laid off and prepared. If the soil is moist enough for the seeds to germinate and no heavy rains fall within two or three weeks, this method is successful, and it has certain advantages over the others. In the first place, where cutworms and changas are present, those pests will cause great damage where the plants are set 4 feet apart, but when there is an abundance of plants it is generally possible to save some. These plants should not be thinned out before they are 12 to 18 inches high, at which time they will be well hardened and will not be subject to the attacks of those insects. Another advantage is that the plants need not be disturbed by transplanting, and if well cultivated and fertilized they will often survive where the transplanted ones would fail.

CULTIVATION.

The tomato field should be cultivated often enough to keep the weeds down and to preserve the soil moisture in dry weather, as well as to aerate the soil when very wet. If only a small amount of fertilizer was applied before planting, another application should be given before the time of blooming. This application is especially for the production of fruit, and should therefore contain a large percentage of potash and phosphoric acid in proportion to the amount of nitrogen.

PRUNING AND STAKING.

Although it may seem formidable to stake a large field of tomatoes, it will pay very well to do so in Porto Rico, where the labor is cheap. In sandy and comparatively dry soil the plants will not attain a very large size, and staking will not always be necessary, but on rich, moist land it is very difficult to keep the vines pruned so every part of the plant can be reached when spraying, and it is wholly impossible to keep the fruits from touching the ground.

The vines may be pruned to one stem and trained to a single stake, but that is usually unsatisfactory here, because the plants are very vigorous and require constant pruning, which can be performed by skilled labor only. The most satisfactory system is trellising, which may be done by driving stout stakes 20 feet apart and setting a braced post at each end of the row; also if the rows are long it may be found necessary to set posts at intervals in the row. Two wires are then stretched at a height of 2½ and 5 feet, respectively, and secured to the stakes by passing a single wire around both and twisting the ends until tight. (Pl. X.) The plants may be left untrained until reaching a height of 2 to 2½ feet, when they should be pruned to one, two, or not more than three stems and tied to the lower wire with cotton twine. After that all new growth below the first wire should be kept trimmed off, and when reaching the upper wire the vines should be tied and not allowed to grow higher.

HARVESTING AND MARKETING.

In Porto Rico tomatoes should be picked for shipment when full grown but before turning red. When the dark-green color has changed to light green or whitish the tomato will ripen up in transit, but when left on the vine a day or two longer it will often reach destination in overripe condition. When picking, it is very important that the fruit should be handled carefully so as not to injure it in the least, because the smallest bruise will cause the fruit to rot. After picking, the fruit is taken to the packing house, where it is carefully graded and culled. All the diseased and injured fruits should be thrown away and undersized and overripe fruit should never be packed for shipment. The fruit is also graded but not usually into more than two sizes, viz, large and medium. The fruit is wrapped in tissue-paper fruit wrappers and packed in baskets holding two layers. Six of those baskets are placed in a crate in two tiers, and the cover is nailed on under slight pressure. (Pl. I, fig. 2.) In shipping tomatoes refrigeration is not necessary, but the crates must be handled very carefully, so as not to injure and bruise the fruit.

TOMATOES, SHOWING METHOD OF TRAINING.

DISEASES AND INSECTS.

Bacterial wilt (*Bacillus solanacearum*) will probably be found to be the most serious disease of tomatoes in Porto Rico. It is one of the diseases which we do not yet know how to combat. It is sometimes introduced by insects, in which case it may occur sporadically, but often it appears to be contained in the soil, and many plants wilt suddenly, others following in quick succession until within two to three weeks not a single plant remains. If the soil is infected there is no known remedy, and such soil should not be planted with tomatoes. When the disease is disseminated by insects it is obvious that the insects should be kept in check.

Blight (*Cladosporium fulvum*) and the downy mildew (*Phytophhora infestans*) are two fungus diseases causing the lower leaves to turn brown and die. Both may be kept in check by spraying with Bordeaux mixture; but, as the old attacked leaves die off and young leaves form rapidly, the spraying should be repeated every week to ten days.

Fungus blight (*Sclerotium* sp.), as described under eggplant, also attacks tomatoes.

Blossom-end rot is a disease appearing on the blossom end of the fruit as black watery spots. It is generally present on the first ripening fruits but not often on the main crop. It can be largely prevented by spraying with Bordeaux mixture containing Paris green or arsenate of lead, commencing when the fruit begins to set and continued until ripening. The insecticide is added because insects probably act as carriers of the disease. Of insects the cotton bollworm (*Heliothis obsoleta*) will probably be the most troublesome here as it is very destructive to cotton.[a]

TURNIP.

This vegetable is not grown extensively in Porto Rico, although it is much appreciated and grows readily. (Pl. IX, fig. 2.) Almost any kind of soil is suitable if it is well drained and not too dry. The crop responds favorably to commercial fertilizer, which should contain large percentages of potash and phosphoric acid.

PLANTING AND CULTIVATION.

Seeds should be sown in rows 1 to 2 feet apart and when the plants are up well they should be thinned out to a distance of 4 to 5 inches. The cultivation should consist, as for any other root crop, in keeping the weeds down and the soil mellow.

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[a] U. S. Dept. Agr., Farmers' Bul. 212 treats of the latest remedies for this pest.

VARIETIES.

The following varieties gave best results at this station: Early Milan, Early Purple Strap Leaf, Red Top Strap Leaf, Scarlet Kashmyr, and Tenoji. The last named is not of first quality, but it was remarkably resistant to black rot in wet soil.

HARVESTING AND MARKETING.

Turnips are ready for the table when large enough, and they should never be left in the ground after being full grown, because they quickly turn bitter and become pithy. When full grown, the roots should be pulled, washed, and tied in bunches of about one-half dozen by passing a twine around the tops. Turnips may be shipped, but not usually with profit.

DISEASES.

The cabbage black rot (*Pseudomonas campestris*) attacks turnips when planted in wet soil or soil containing much vegetable matter, and such should be avoided when planting.

WATERMELON.

The watermelon is not much appreciated in Porto Rico, probably on account of the poor quality of the fruit usually produced here, which is caused entirely by planting seeds of poor varieties. Watermelons will grow on any soil from sand to heavy clay, with a preference for light loam of good water-holding capacity without being soggy. A dry soil, as well as a soil which becomes soggy with every rain, can not be expected to give good results. Newly cleared land is well suited to this crop. If old, weedy land is selected it should be planted with legumes, which should be kept clean until they cover the ground, and when fully grown should be plowed under and left until well rotted. The land should be marked off in rows 10 feet apart, and the rows plowed out by running a double furrow for a trench in which to apply the fertilizer. For fertilizer a stable manure with an addition of potash is very good. If stable manure is not avaliable a commercial fertilizer containing 3 per cent nitrogen, 9 per cent potash, and 9 per cent phosphoric acid should be applied at the rate of 500 to 1,000 pounds per acre. If a crop of legumes has been plowed under, less nitrogen will be necessary. The fertilizer should be applied in the trench and mixed with the soil by running a cultivator through it several times, after which the trench should be filled up by plowing two furrows together. This leaves a raised bed on which to plant the seeds.

PLANTING AND CULTIVATION.

Watermelons should be planted 8 to 10 feet apart by dropping 8 to 10 seeds to the hill in a space covering a square foot, more or less. When the plants have grown enough to be out of reach of insects they should be thinned out, leaving only two plants to the hill. After thinning a pinch of nitrate of soda applied and worked into the soil in the hill will start the plants off well.

Cultivation consists mostly in keeping the soil clean, which can conveniently be done with a horse cultivator. The time in which it is possible to cultivate is comparatively short, because the vines soon cover the ground, and it should therefore be strictly attended to while it is possible.

VARIETIES.

Good eating qualities and good shipping qualities are seldom found in the same fruit, therefore in selecting varieties the distance of the market should be considered. For home use or for the home market Kleckley Sweet, Sweetheart, and White-Seeded Ice Cream are excellent. The Sweetheart and White-Seeded Ice Cream would also stand shipment to the United States if carefully handled. The Kolb Gem and Cuban Queen have thick, tough rinds and solid flesh; they are, therefore, well adapted for shipping, but their quality is inferior. Other varieties recommended for shipping are Dixie, Florida Favorite, Lord Bacon, Rattlesnake, Duke Jones, and Jones Jumbo.

HARVESTING AND MARKETING.

In the matter of determining just when a melon is ripe, everybody fully realizes that practical experience is the only guide. If the vines are healthy the tendril attached on the opposite side of the vine from the melon will wilt when the melon is ripening; but this is not a sure guide, because it may wilt a week or more before the melon is ripe and it may keep green after the melon is overripe. Another sign is found in the appearance of the underside of the melon, which is more or less white spotted from contact with the soil. When the spots turn yellowish and the rind appears warty and is hard when scratched, the melon is nearly ripe. The only sure way is to thump the melon and judge the state of ripeness by the sound emitted. The unripe melon when flipped with the finger emits a ringing sound like some hollow body, while the ripe melon emits the dead sound of a solid body.

In harvesting the melons a packing house is not necessary. The fruits should be picked, loaded upon a wagon, and hauled directly to the wharf. In shipping, none but large melons should be used, as a small melon does not pay for the freight and expenses. In shipping melons from Porto Rico it should be remembered that in the winter months the demand is very limited; but a small amount of first-class

fruit will always bring fancy prices. In the spring and early summer before the southern melons come into the market the Porto Rico melons should bring a good price, but later in summer it would not pay to ship from here.

DISEASES AND INSECTS.

The melon leaf spot (*Cercospora citrullina*) did some damage to melons grown at this station. It appeared on the older leaves as dark spots, causing them to dry up and die. It can be kept in check by spraying with Bordeaux mixture.

Blossom-end rot nearly always attacks the early ripening fruit, but is seldom destructive to the main crop. It can largely be prevented by beginning to spray with Bordeaux mixture when the first fruits are setting and repeating the spraying three or four times until they are ripe.

Of insects, the striped cucumber beetle is more or less destructive. (See under "Cucumber," p. 35.) The melon aphis (*Aphis gossypii*) often infests the underside of the leaves. The "lice" are small green insects well known to every gardener. They live by sucking the plant juices, and can therefore not be killed by stomach poisons, but are kept in check by kerosene emulsion, whale-oil soap, and other remedies.

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